

Printed for the use of the Colonial Office, &c.

Miscellaneous
No. 266.

REPORT

BY

MR. ARTHUR PICKELS,

M.B., B.S., D.P.H., SENIOR SANITARY OFFICER,
SOUTHERN NIGERIA,

ON A

VISIT TO THE AMAZON RIVER, PANAMA,
CUBA, &c., FOR THE PURPOSE OF
INVESTIGATING YELLOW FEVER AND
MALARIA.

COLONIAL OFFICE,
August, 1911.

THE PROPERTY OF
THE WELLCOME BUREAU
OF SCIENTIFIC RESEARCH.



22501885653

Miscellaneous
No. 266.

REPORT

BY

MR. ARTHUR PICKELS,

M.B., B.S., D.P.H., SENIOR SANITARY OFFICER,
SOUTHERN NIGERIA,

ON A

VISIT TO THE AMAZON RIVER, PANAMA,
CUBA, &c., FOR THE PURPOSE OF
INVESTIGATING YELLOW FEVER AND
MALARIA.

W C 530
1911
p 59 v

REPORT

BY

MR. ARTHUR PICKELS

ON A

VISIT TO THE AMAZON RIVER, PANAMA, CUBA,
&c., FOR THE PURPOSE OF INVESTIGATING
YELLOW FEVER AND MALARIA.

17208.

MR. A. PICKELS to COLONIAL OFFICE.

(Received 26 May, 1911.)

SIR,

Liverpool, 18th May, 1911.

I HAVE the honour to inform you that in accordance with the directions contained in your letter, No. 421/W.A., dated January 17th, 1911, I left London on January 21st and proceeded on my journey, visiting places on the Amazon River, the Isthmus of Panama, Habana, and several of the West Indian Islands, as time and opportunity allowed.

The following was my itinerary :—

Left London, January 21st.

Para, February 8th-11th.

Manaos, February 15th-March 2nd.

Barbados, March 11th-13th.

Trinidad, March 14th.

Isthmus of Panama, March 19th.

Kingston, April 6th.

Cuba, April 8th-11th.

Arrived back in England, April 30th.

In the whole course of my journey I met with the utmost courtesy and kindness from all with whom my work brought me into contact, and from them received every facility and assistance ; especially do I wish to record my indebtedness to His Britannic Majesty's Ministers at Panama and Habana, the Consuls representing the Governments of His Britannic

Majesty and the United States at Para, Colonel Gorgas and his staff at Panama, who rendered my stay on the isthmus both enjoyable and instructive, Dr. Guiteras, who was most kind in showing me the chief points of interest and giving me all the information possible in the time at my disposal, Dr. Thomas, who represents the Liverpool School of Tropical Medicine in Brazil, without whose personal kindness and professional assistance my visit to Manaus would have been bereft of most of its results, the Surgeon-General of Trinidad and Dr. Dixon, and the medical officers in charge of the hospital and asylum at Kingston.

Attached I have the honour to forward my report on those points and conditions which appeared to me of special interest in relation to sanitary work on the West Coast of Africa.

I have, &c.,
ARTHUR PICKELS.

Enclosure.

REPORT on my Visit to the Amazon River, the Isthmus of Panama, Cuba, &c., with the object of gaining information in regard to Yellow Fever, its treatment and the methods adopted to eradicate both it and Malaria in those parts.

YELLOW FEVER.

1. In a pamphlet "Do you know the wealth of Brazil?" written for the Brazilian Government by Paul Perrin, and published in 1910, I saw the statement: "Yellow Fever has completely disappeared from Brazil."

However, immediately on my arrival I found that this was not the case, and through the courtesy of the physicians attached to the hospitals there, who most kindly gave me every facility, I was enabled to see quite a large number of patients suffering from the disease. During the period of my stay in Brazil, which, considering the object I had in view, was at a most fortunate time, I saw, in all, about 60 cases of the affection in its various stages.

I am deeply indebted to Dr. Thomas, of the Liverpool School of Tropical Medicine, who is working in Manaus, for his very great and willing assistance which, in view of my ignorance of the Portuguese language, was invaluable.

2. *Distinction of yellow fever cases.*—In going round the wards I noticed it was unnecessary to inform the physicians which were the yellow fever patients, as they distinguished them at a glance, and I soon began to understand how it was possible to do this. Most of the patients were admitted into hospital on the third or fourth days of the disease, so that unfortunately I only saw very few in the early stage.

3. *Appearances and symptoms.*—The onset of the attack in most cases was sudden. The appearance of the patients was distinctive. The dull flushed condition of the face, congestion of the conjunctivæ, expression of anxiety, a look of alertness in the eyes with, even in some of the early cases, a suggestion of a yellow tinge, and no special restlessness, at once attracted attention, and on examination and enquiry other symptoms were elicited, viz., heat, headache, occasional vomiting, pains in the back and limbs of a muscular character, often faulty circulation observed on pressure on the skin, which at the same time showed a faint yellowish colouration which was not always otherwise observable.

The congested appearance of the conjunctivæ was often very marked, especially on the palpebral portion, where I always found it if it were not specially in evidence over the eyeball. Pain in and behind the eyes was more common than photophobia, which did not come much to my notice. The tongue was, in the majority of cases, red, the edges and tip especially so, and very pointed, with the papillæ swollen and prominent. Later, in some cases the posterior portion became coated with a bilious fur, but the tip usually continued more or less as described. The gums were often swollen, bled easily, and oozing was sometimes observable. A red line at the edge of the gums close to the teeth was often marked, especially in the lower jaw. Tenderness was almost invariably elicited, if pain were not actually complained of, over the epigastric region or just below the edge of the ribs on the right side in the region of the gall bladder.

In uncomplicated cases the spleen was not specially noticeable.

In the later stages jaundice was more marked and unmistakeable.

Black vomit occurred in many cases, usually beginning as a few black specks or "fly wings" in a clear fluid, and later becoming more marked. At this stage the vomit on standing soon separated into two layers, the black specks settling to the bottom, leaving a clear fluid above. Later, the vomit became black, thick, and inseparable, or might be slaty or

brownish black. If, as in some of the cases, the hæmorrhage was profuse, the vomit was red and occasionally appeared to be pure blood. Care must always be taken to distinguish between the red blood of "black vomit," and the vomiting of red blood in the early stage which has been swallowed from the nose.

The vomiting is of a sudden gushing character in this stage. The patient, while lying quite still, and without any retching, suddenly vomits a quantity of fluid without any effort, and often before he is able to turn over, and then at once lies down again.

The bowels are usually costive, especially at first. The fæces may early have a "bismuth" appearance or become tarry. Severe hæmorrhages are a late manifestation, and, in one case I saw, the patient, the bed, and the floor were covered with blood.

As I only saw a few cases in the very early stages I was unable to satisfactorily make out Faget's pulse curve in relation to the temperature, although it was distinct in one or two instances. A slow or even very slow (48 was observed) pulse was a frequent feature, following the fall of temperature after the initial rise, when there was no secondary fever. After the early stage, if the temperature continued, or if it rose again, the pulse curve followed it.

Abscesses occasionally occur, and parotitis, which may suppurate, seems to be fairly common.

Collapse, which often terminates fatally, is frequent, and requires very careful watching.

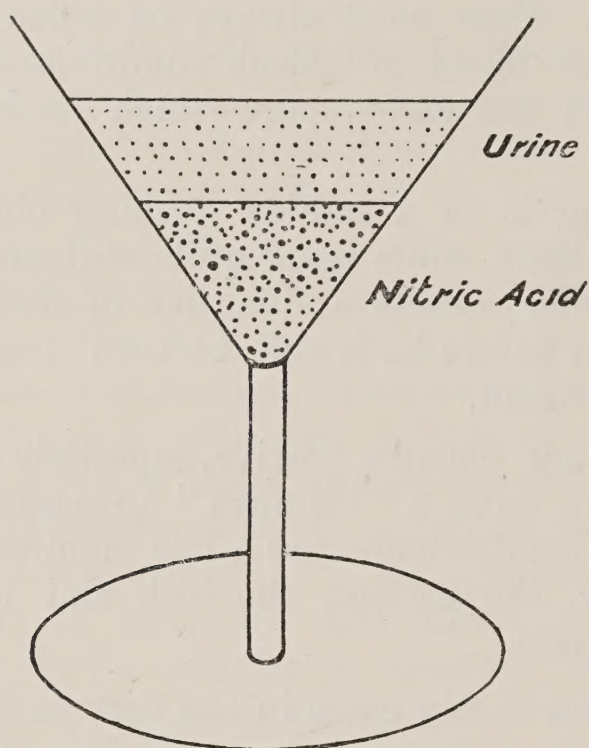
I saw no case of hyperpyrexia, death occurring in all instances from other causes.

Albuminuria was present in practically all cases, although in some it had to be most carefully and frequently sought.

Hæmorrhage from the kidneys is very infrequent, and I obtained no history of hæmoglobinuria ever occurring.

Dr. Thomas informs me, in reference to albuminuria, that he almost invariably obtains a positive result at some time in the course of the first few days. The following is the method he employs, viz., a conical glass about 2 inches deep is half filled with filtered urine. Nitric acid is taken in a pipette and carefully introduced to the bottom of the glass. When sufficient acid has been put in under the urine (about $\frac{1}{2}$ - $\frac{3}{4}$ inch in the glass) the pipette is very carefully withdrawn

along the side of the glass without disturbing the liquid. Allow to stand a little if no shade appears at once.



Suppression of urine, partial or complete, occurred in a fairly large proportion of the cases, and the latter was always fatal.

Hiccough is fairly common, and often very troublesome.

The cases which I saw varied very much in severity from those which were convalescent after 24-48 hours to fatal cases of collapse, hæmorrhage, or suppression of urine. There are others which, with their complications, extend over a period of several weeks.

I was fortunate enough to see Dr. Thomas make several post-mortem examinations, and he also showed me pathological specimens in his laboratory which had been previously obtained.

In the post-mortem rooms jaundice was marked, and the viscera were tinged yellow in varying degrees.

Fluid found in the peritoneum, pleuræ, and pericardium was also yellow.

The contents of the stomach varied from clear fluid with a few black flakes to distinct "coffee ground" vomit or very dark grumous material. The stomach walls were congested and showed hæmorrhagic spots. Rugæ were markedly noticeable. (It has been stated that the appearance of the Rugæ, like a bundle of *Ascarides*, is typical of the disease.)

The kidneys were in all cases much congested and, in one instance, showed petechial hæmorrhages under the capsule.

Hæmorrhages of this description were also seen under the visceral layers of the pleuræ and pericardium.

The liver always showed fatty changes but not always the typical "boxwood" appearance, although one very good instance of this was observed.

4. *Treatment*.—From all the information I could obtain, I gathered that rest, as absolute as was possible, should, in this most exhausting disease, be given, in order to conserve the strength, and that, therefore, efficient nursing was one of the most important items.

A very great point is to get the patient as early as possible in the disease, the mortality being very much higher in those who have delayed seeking skilled advice. When seen early the induction of sweating by means of a foot bath, with or without mustard, hot drinks, and blankets, &c., is often very useful and gives great relief; but, unless the case is seen then, this procedure is too exhausting and is associated with some danger.

Drugs such as Phenacetin, Antipyrin, &c., are looked on as too depressing and are not used, but a dose of Pyramidon is sometimes given at this time.

An initial purge of Calomel (5 grains) and Rhubarb with a saline following, if necessary, is practically always administered, and the patient is placed on an alkaline mixture of Soda or Magnesia, although the latter is by some said to give rise to flatulence.

Alkaline enemata are given three or more times daily, the composition of which varies with the physician. Some order them containing 30 grammes of sulphate of soda to the litre, others only give 10 grammes to the litre and add a little bi-carbonate of soda, and, in some instances, only a solution of bi-carbonate of soda is employed. They are given warm or cold, according to direction, but in the latter case give rise to a good deal of pain.

The objects aimed at in giving these enemata are :—

- (1) Purgative, to assist in getting rid of the toxin and keep the bowels clear.
- (2) Stimulant and tonic, both general and local, to kidneys.
- (3) Antipyretic.

Enemata are not given with the object of being absorbed and thus supplying fluid to the circulation.

Theobromine is administered almost as a routine practice to assist renal secretion, and always if any tendency to its diminution is noticed.

If the diminution becomes more pronounced or suppression occurs, dry cupping is done and mustard or linseed poultices applied.

As a means of lowering the temperature, baths are used, cold spongings, washing with vinegar, or alcohol, &c.

In cases where there is much gastric pain or vomiting, ice bags are applied locally or ethyl chloride is sprayed over the epigastrium at intervals. This latter, however, must be done with care. When hæmorrhages have come on, nothing seems to be of any avail. Adrenalin, Ergot, &c., have no effect.

If from appearances early on in the case (marked congestion of face, eyes, feet, &c.) it appears as if hæmorrhages may probably occur later, Adrenalin, if commenced at once, seems occasionally to be of some advantage.

The pulse must be very carefully watched in all patients suffering from this disease, so that the necessary steps may be taken to ward off symptoms of collapse. Should it begin to fail hypodermic injections of Caffeine are given at regular intervals. Brandy and champagne, especially the latter, are freely administered. Rubbing with vinegar is practised and hypodermic injections of oil of camphor are given, which, however, give rise to a great deal of pain.

No special treatment is adopted for "black vomit."

In cases where the affection is complicated by malaria, no treatment is adopted for the latter until the patient has recovered from the yellow fever.

Murray (United States Service) however, recommends that in specially malarial districts a large single dose of a quinine salt be administered during the first 12-24 hours of the disease, if seen at that time.

As regards food, the stomach must have as complete rest as possible for several days. All must be absolutely stopped and the patient only allowed some iced alkaline water to drink, such as Vichy, which is invariably used in Brazil. He may, however, take as much of this, in not too large quantities at a time, as he feels disposed. Should, however, the vomiting be incessant, it is advisable to stop everything for a time and then recommence with very small quantities of fluid. This is continued for several days and very great care and judgment must be exercised in commencing food and making additions to the diet.

5. *Remarks.*—In comparing the cases of fever which we meet with on the Coast with those which I saw in Brazil, the former, taking them as a whole, do not present the same aspects or combination of symptoms as the latter. There is

not associated with them the anxious facies, the quiet but alert look (as Touâtre says : "the yellow fever patient is, as a rule, mentally alert," "the malaria patient doesn't care what happens"), the marked conjunctival injection, the peculiar character of the tongue, the jaundice, the almost invariable presence of some degree of albuminuria, the comparatively frequent partial or complete suppression of urine (the latter being, in my experience, extremely rare indeed if hæmoglobinuric fever be excluded), nor any hæmoglobinuria and the relation of pulse and temperature, as stated in "Faget's Law," is not a feature specially noticeable in our cases. I have seen a few instances of very slow pulse following an attack of fever which appeared to be malarial, but they are not common.

In looking back, however, I can specially call to mind two cases, the symptoms of which bore a striking resemblance to those I have just seen in patients suffering from yellow fever. At the time I noticed the difference between them and those associated with our usual cases, but was unable to interpret the significance of it. In all probability these, I now think, were instances of yellow fever.

In the public mortuary I have also seen cases in which the cause of death was not as plain as one would like, and in one or two instances I recollect the liver bore some resemblance to those I have now become acquainted with.

With regard to "bilious remittent" fever, which some seem to consider a special variety of malarial fever, the term has, I think, been very loosely used in the past. To my mind it is a confusing term which could with advantage be dropped. In some instances it certainly is a manifestation of malaria, but in others (if the presence of yellow fever on the Coast be granted) it is almost as certainly yellow fever.

Dr. Guiteras appears to hold the view that, at any rate in most cases, "bilious remittent" fever is really yellow fever, and, in conversation, stated that since yellow fever had been eradicated from Habana "bilious remittent" and the "coffee ground" fever of children had disappeared, although malaria still remained.

ANTI-YELLOW FEVER MEASURES.

Para.

6. In October, 1910, Dr. Oswaldo Cruz visited Para, bringing with him a large staff, and officially commenced anti-yellow fever work in the town. After remaining some

little time he returned to Rio, leaving its continuation in the hands of Dr. João Pedroso B. de Albuquerque, who is now in charge of the arrangements, and who most courteously took me round and gave me every facility for seeing what was being done and the methods employed.

Dr. Pedroso, who is quite separate from the Municipal Sanitary Authorities, although they mutually assist each other, has with him 16 medical officers and a staff of inspectors and fumigators, all of whom were brought up to Para.

7. *Inspection of Town.*—The town is divided into districts, every house in each being visited at least once a week.

Mosquito-breeding places are sought for and treated, and all tins, rubbish, &c., are collected and removed.

8. *Cases of Yellow Fever.*—The assistance of the medical men in the town has been obtained and all cases which arouse any suspicion of yellow fever are at once reported. On a report being received, the patient is at once visited by Dr. Pedroso or one of his assistants and, even if only considered suspicious, is removed at once in a mosquito-proof conveyance to the mosquito-proof wards of a hospital either for observation or treatment, or both.

If the house in which a patient was taken ill be a good one, his room is made mosquito-proof at the expense of the Government, and he is allowed to remain in it. Immediately after removal the fumigating staff visits the house and fumigates both it and those buildings in the vicinity and special vigilance is exercised by the inspectors in that district for the next 15 days or more.

The mosquito-proof conveyance is after the style of a country hotel bus which has been rendered mosquito-proof. It is provided with seats on each side, but no arrangements for patients lying down are made.

9. *Results already obtained.*— Since the work was instituted, there has been a very considerable diminution of the number of cases, as the following figures will show :—

In December, 55 cases were reported.

In January, 32 cases were reported.

In February (up to the 10th), 15 cases were reported—
of which 3 turned out to be yellow fever,
and 2 out of the 3 were from Manaos.

10. *Precautions against Manaos.* — Para looks upon Manaos (which is 3–4 days' distance away and from which about 10 steamers arrive weekly) as the great source of infection.

All steamers arriving at Para have to anchor at least 1,100 yards from the land and are then visited by the Port

Medical Officer. If there are no sick, all passengers are allowed to land ; but should there be the cases are at once seen, and if considered suspicious in any way, Dr. Pedroso informed and the ship visited by one of his assistants. The patient is then removed to the hospital for observation and treatment and the remaining passengers are allowed to land, but are under surveillance for 15 days or more.

No steamer from Manaus is allowed at the quay under any circumstances without being previously fumigated, although, if there is no sickness on board she may discharge into lighters at her anchorage in the river. If, however, yellow fever has been on board, fumigation is compulsory, whether she discharges or not.

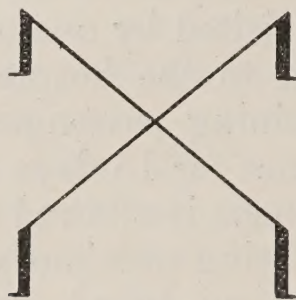
11. *Yellow Fever Hospital Wards.*—The hospital wards for yellow fever have been placed under the care of Dr. Pedroso and are visited daily or oftener, according to circumstances.

12. *Burial of Yellow Fever Patients.*—Patients who die from yellow fever are not buried in the usual cemeteries, but in a place apart by themselves.

13. *Fumigation.*—Fumigation is done immediately a patient has been removed from his house. No objection is raised by the people ; in fact, they and the other householders in the neighbourhood are glad to have it, and give the fumigators every facility.

The fumigating band, under the supervision of a medical officer, takes complete charge of the building as it stands. Articles which would be injured by the fumes are removed if possible, but if not, are adequately protected against their action. Metal work, clocks, &c., are removed. Pianos are wrapped in a large cloth and sheets of paper are pasted together over the cloth so as to totally exclude any fumes. Silk clothing, &c., is well shaken and shut up in a thoroughly clean wardrobe, which is sealed up with paper. All openings, doors, windows, &c., are carefully sealed with paper. When it is impossible to close all the cracks and crevices by means of paper, large cloths of grey baft are thrown over the building, roof, or space, and carefully fixed down to the walls or ground with long narrow strips of wood. All outhouses are done in this way, and in some instances the roofs of ordinary buildings have to be similarly treated. Fumigation is carried out with sulphur or pyrethrum, the latter only when the former, which is considered the better, is inadmissible. The sulphur, with which a little nitre is mixed to make it burn better, is burnt in iron pans 6 inches to 7 inches in diameter and not more than 1 inch deep,

supported on a four-legged iron stand, so that the pan itself is 3 inches to 4 inches from the ground.



A little alcohol is added to assist the sulphur in commencing to burn. One or more of these pans is placed in each room or compartment and also between the ceiling and roof.

No accident has yet resulted as a consequence of using this method.

After the sulphur is fired and every opening stopped up, the place is left closed for $1\frac{1}{2}$ hour, if sulphur be used, and 3 hours if pyrethrum. In a properly sealed up place sulphur is burnt in the proportion of 20 grammes per cubic metre and pyrethrum in half that quantity. In a place which cannot be properly sealed up sulphur is used in the proportion of 30 grammes per cubic metre.

After the process is completed the men go back, clean up, and put things in order again.

The owners or occupiers are requested, when all is over, to sign a paper stating whether any damage has been done, and if so its value.

Reparation is made by the Authorities for any articles injured or broken, &c.

I was fortunate in being able to observe the process of fumigation in several houses.

14. *Water Containers*.—All cisterns and water containers have to be screened at the expense of the owners, and to the satisfaction of the authorities, and to each cistern is attached a certificate showing when the screening was done and who certified to its efficiency.

15. *Larvicide*.—As a larvicide kerosine is used, and is often mixed with 5 per cent. of creolin.

16. *Administration*.—The staff employed consists of :—
Dr. Pedroso.

16 medical officers.

3 inspectors to attend to cleaning up and mosquito-breeding places, having 120 men under their direction.

3 inspectors, who attend to fumigation, with 90 assistants.

In addition there are the necessary clerks, storekeepers, chauffeurs, cartmen, &c.

There is a central office in the town and a store, with stables, &c., attached, nearer the outskirts.

Motor cars are used to increase the facilities for getting about.

Carts and ambulance carriages, with horses or mules, for the transport of patients and the necessary material are also provided.

All tools and materials which may be required in any part of the work are kept in a large store and issued when required on a requisition signed by a medical officer.

17. *Cost.*—The cost of the work per month is between £9,000 and £10,000, but the result is already beginning to show its justification.

Considering the cost of things in general, the usual scale of salaries and wages, and that the whole staff has been brought up from Rio, this sum, which may appear excessive, is not really so large as it appears.

Manaos.

18. *Men Employed.*—The anti-yellow fever work is done here under the direction of the Town Health Officer by a gang of 70 men, who, I understand, are said to work from 1.30 to 4.30 daily, which includes time occupied in changing in and out of uniform.

19. *Fumigation.*—Fumigation is done occasionally, but at the time of my visit, although sadly needed, there was no material to do it with.

20. *Work already done.*—Dr. Thomas informs me that a good deal of cleaning up and some reclamation has been done although many of his recommendations have not yet been carried out, and also that in a very large percentage of the compounds mosquito larvæ can be found.

21. *Water Supply.*—The water supply is intermittent and cisterns and other water containers have to be used, but screening of them is not properly enforced.

22. *Yellow Fever Hospital Wards.*—In one of the hospitals there are yellow fever wards (for males only) which

are nominally mosquito-proof, but in the other yellow fever patients are placed in the general wards. In this latter hospital there is no mosquito proofing at all, and although at one time one ward was screened for them, the gauze was all removed almost immediately after Dr. Thomas had left on his way home, as it happened.

Even if anti-yellow fever work were carried on by the Authorities in a more satisfactory way, I have reason, from both personal observation and hearsay, to believe that there are many cases of the disease which are not called yellow fever.

Panama.

23. Yellow fever, which, only a few years ago, was so rife in this part, has now and for some considerable period been completely eradicated as a local disease, so that all real anti-yellow fever measures have for some time been merged in the general sanitary work.

24. *Time Taken to Obtain Results.*—In Panama itself the whole town was gone through by the fumigating gangs, and every house fumigated three times before any result which could be considered satisfactory was obtained, but the present condition has fully justified to the lay mind the perseverance shown, and the large and continued expenditure of money.

In fumigation, which is done with sulphur in the usual way, flowers of sulphur is used in preference to the roll form, as it burns better and quicker, and therefore sooner gives a greater density of fumes. It is burnt in the usual manner—in an iron pot standing in a larger one containing water (sometimes the iron pot which contains the sulphur cracks). A layer of dry earth is placed in the iron pot underneath the sulphur, as it prevents sticking and very considerably facilitates cleaning.

Tin measures which hold the quantities necessary for definite amounts of cubic space are used for measuring out the sulphur.

Habana.

25. The anti-yellow fever measures which at one time were necessary in this city have, except as regards hospitals, been merged for a long time in the methods adopted for general sanitation in the tropics.

HOSPITALS.

Para.

26. In Para there are four hospitals where yellow fever patients are accommodated and treated.

The yellow fever hospital proper, which is under the Yellow Fever Commission (the Doming F. Hospital), is situated outside the town and some distance away from all buildings. It was erected in 1899, and at a later period was made mosquito-proof from roof to basement.

The hospital itself is on one floor raised above the ground with a basement underneath at the ground level. All the wards, of which there are large and small, are beautifully large (as regards bed space), lofty, light, and airy. In all places where the mosquito screening is liable to damage by patients, &c., it is protected by half-inch wire netting placed an inch or more from it.

There are three other hospitals, all of which have mosquito-proof wards for yellow fever patients, and similar rooms for observation until a definite diagnosis can be made.

27. *General Wards.*—In the general wards of the hospitals only a certain proportion of the beds are provided with mosquito-nets. These are hung on a circular disc which is suspended from the ceiling and can be raised or lowered as desired.

In the daytime they are simply hoisted up, leaving a circular cylinder of net open at one end, and at night are let down and opened out so as to surround the bed.

In no instance during my journey did I see a mosquito-net tucked in or even arranged for tucking in, and only once did I see a net used in a manner which I considered satisfactory.

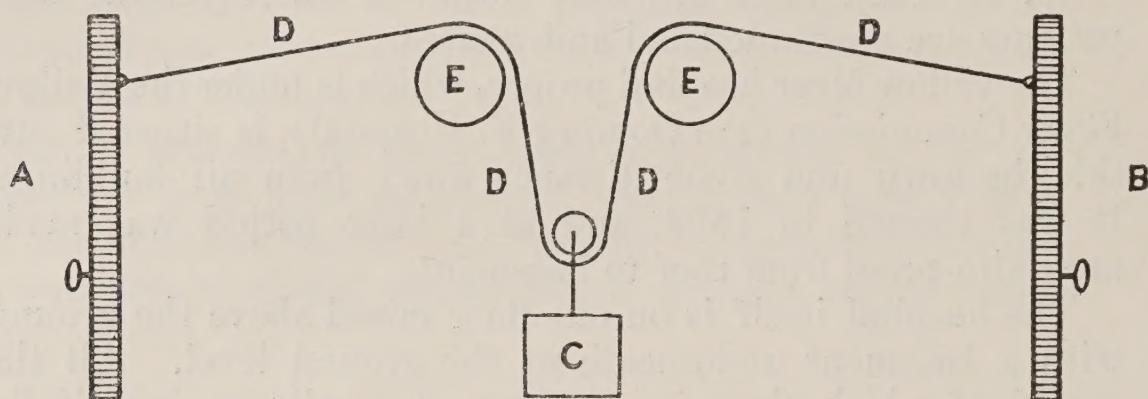
In these hospitals the operating theatres were of an up-to-date character, and large sums must have been spent on their erection and equipment.

28. *Small-pox and Leprosy.*—There is a small-pox hospital outside the town and also one for lepers, but segregation of the latter is not compulsory.

29. *Nursing.*—All the hospitals are nursed by sisters of the religious orders in the town.

30. *Entrance Doors.*—The entrance to all mosquito-proof wards is through a double door. A small compartment, about 4 to 6 feet long, is made in the doorway, usually half inside and half outside the ward, which has a door at each end opening outwards from the compartment, both being fitted with springs to keep them closed. In addition there is

a string and pulley arrangement which prevents both doors being opened at the same time, and the opening of one door shuts the other.



A and B are the doors.

C is a weight hanging loosely and running on the rope D.
E are pulleys (fixed).

When A on opening pulls the rope D, C is drawn up against the pulleys and B cannot then be opened. As A shuts C falls and then B can be opened.

Manaos.

31. There are here two large hospitals which, however, are not as good as those at Para.

The Government Hospital, which takes both paying and indigent patients, situated in the town with no open space around it, is the less satisfactory. It makes no special provision for the isolation of the yellow fever patients and provides no mosquito-nets. At one time one of the wards was screened for the accommodation of the above patients, but later the wire gauze was all cut down. The other hospital (Societate Beneficente Hospitale) is a "Society" hospital admitting its members free, and paying patients only if there be room. It is in a better and much more open position than the former institution, but behind it is a swampy area with much rubbish. It has screened wards for male yellow fever patients and for those sent in as suspects with the diagnosis unconfirmed. The beds in the general wards are provided with nets which, however, are not all used.

Female yellow fever patients are placed in the general female ward.

All the nursing is done by the religious orders in the town.

32. *Small-pox and Leprosy.*—The small-pox hospital is a mud erection situated a short distance up the river. When it is not required for small-pox patients it is used by lepers who only go of their own free will and are turned out if accommodation is so required.

S.S. Ambrose.

33. This steamer of the Booth Line has a small hospital with two rooms (each having two beds) and bath and lavatory accommodation in connection with it. A nurse is carried who takes charge of sick patients. The beds are about the same size as bunks, but are movable, and the nurse is able to get all round the patient as may be required.

Ancon Hospital.

34. This is the Headquarters Hospital.

It is a hospital of many pavilions raised off the ground (mostly of two storeys). These are situated on the side of Ancon Hill, Panama, and are on a much higher level than the flat ground near at hand. All are completely mosquito-proof (including the verandahs). Only single doors are used and all open outwards.

The wards are wide, lofty, light, and airy, and are, together with everything in them, painted white. The bedside tables are made of metal framework with a glass top, and the beds are placed two feet from the walls.

There is a General Superintendent over the whole administrative part. An officer directing the medical work and another that appertaining to surgery, who have a staff of 25-30 medical officers under them, are in charge of the various wards. The nursing is done by 100 white nurses who have trained coloured attendants to assist them.

There are isolation wards for infectious diseases and an insane asylum with 300 beds in the grounds.

Each ward building has a laboratory attached where routine examinations are made of the blood, urine, and the faeces of every patient, in addition to other work.

The operating theatre, originally built by the French, is a large, well-equipped structure, with various rooms. In it a large amount of the work is done and several operators are kept busy every day, working at the same time.

Electric lights are kept burning continuously in the glass instrument cases, which, in the moist atmosphere, greatly assist in keeping their contents in good condition.

The married medical officers have separate bungalows, the others occupy rooms in a large three-storied building.

A well-appointed mess-room for the use of doctors and nurses is also provided.

There is a large laundry in connection with this hospital where the washing from all the hospitals and dispensaries in the Canal Zone is done.

In connection with this hospital is a library provided by the Commission, for the use of the medical officers, where all the latest works, magazines, reports, &c., can be seen and read.

The pathological laboratory is a separate, well-fitted building in the grounds, and in connection with it, in addition to the Pathologist, is a Bacteriologist, a Physiologist, a Chemist, and an Entomologist.

At all Canal Zone hospitals all employés are admitted free unless they desire special accommodation, and their wives and children are charged small fees, with the same exception.

Anyone is admitted on payment and those unable to pay are taken in free. All the milk used in this institution is obtained from cows imported by the Commission and kept on a farm not far from the hospital.

Colon Hospital.

35. This hospital, which is under the charge of Dr. Bell, who most kindly showed me all over it, was originally built by the French, and consists of numerous buildings. Parts are built on cement pillars over the sea and the tide comes up beneath, but all the pavilions are raised off the ground. There are 550 beds, which number can be raised to 600 if need arises.

The staff consists of 16-20 doctors with 45 white certificated nurses, which, together with the subordinates, make a total of 153. Native attendants are trained and do very satisfactory work.

All the wards (white and coloured) are mosquito-proof, but the sea air very rapidly affects the gauze, which requires frequent renewal. In contradistinction to Ancon Hospital, however, the wards only are screened and not the verandahs.

The patients have good spring beds, the bedside tables are of metal framework with glass tops, and the wards and everything in them are painted white. The different blocks are two-storied buildings, and a mess-room is attached to each for convalescent patients.

A large well-appointed mess is provided for the doctors and nurses.

There are two operating theatres, one of which is for clean cases only. A third theatre is for eye operations in connection with the eye clinic.

Small laboratories are attached to each block for use of the medical officers, and in addition there is also a larger and better equipped one for special work. The dispensary is

clean, neat, and well fitted. Isolation wards are provided for infectious cases.

Dr. Bell has put cement sinks in many of the ante-rooms to the wards, which are a great convenience and have been made at small cost.

Water is obtained from the town supply, but in addition there is a distillation apparatus always kept working. Hot and cold water are supplied to each ward. As far as possible electricity is used, even down to a potato-peeler.

As at Ancon, a library is provided for the use of medical officers.

Local Canal Hospitals.

36. At each station on the line is a dispensary and dispenser, with a medical officer in charge, who has also what is called a "sick camp," which is really a small hospital for minor cases of short duration.

Sick Train.

37. This consists of two carriages which make one journey from Colon to Panama and back daily, being attached to ordinary passenger trains.

Each is a long compartment with large doors in each side for lifting patients in and out, and smaller ones at the ends.

Six or eight canvas beds are placed in each, similar to those in the labourers' barracks, and stretchers are also supplied in addition for carrying patients, which, if necessary, are used as beds.

Quarantine Station, Panama.

38. This is situated on an islet between two islands and is about three miles from Panama.

The staff consists of a medical officer and 21 employees.

There are nine buildings in the station of a bungalow type, all of which are mosquito-proof. The building for steeage passengers has two floors.

There is a kitchen and a dining-room, and all the necessary conveniences are in duplicate on both floors. Beds like those in the labourers' barracks are provided.

Cabin passengers have a large two-storey building with a hall in the centre, which is used as a dining-room, and a number of small rooms, each with two doors and two windows, containing four beds each. All necessary conveniences are in duplicate on both floors. The kitchen with

store-room and refrigerator is attached but is a few yards from the main building.

There is a hospital for plague, with two rooms, and another for yellow fever patients, with four rooms, each with necessary conveniences. These buildings are away from the rest and are on stone pillars between which the sea washes. There is an office and laboratory, and quarters for medical officer and attendants.

Water Supply.—Salt water is used for fire and sewage purposes. This is pumped into a cement reservoir on the top of the neighbouring island. It supplies fire plugs, which are in all the buildings and also in the grounds, and all the sanitary arrangements.

Fresh water is collected from roofs in circular tanks, 20 feet diameter and 20 feet high, in the wet season, but all the other supplies have at present to be brought from Panama.

The pumping machinery consists of two steam pumps. Two are provided for fear of one breaking down, and one is kept working 2-3 days a week.

Ships coming up the coast, *e.g.*, from Guayaquil, are inspected by an American representative at that place, and fumigated before sailing, so that the quarantine period starts from there.

The baggage of cabin passengers from a ship arriving from a yellow-fever port is not fumigated, but that of steerage passengers is so treated, in order to destroy any living organism there may be.

Grain, hides, &c., are forbidden altogether.

Leper Asylum, Panama.

39. This institution is situated about three miles from Panama ; it has to be reached by boat from that place, and is on the slope of a hill close to the sea shore.

A white superintendent is in charge and the place is visited by a medical officer once weekly.

It consists of a number of small buildings of the bungalow pattern, raised off the ground, with a verandah all round. Each building has two, three, or four rooms which are provided with one, two, or three proper bedsteads and bedding. Water is laid on and suitable bath, lavatory, and washing accommodation arranged for in every house.

The buildings are not mosquito-proof but cases of malarial fever are rare.

Water Supply.—The water supply is obtained from a well in the grounds from which water is pumped, by means of a steam pump, into a cement reservoir which is at sufficient elevation to provide the necessary pressure. The sewage goes into the sea. There is a small chapel in the centre of the grounds which is also used as a school for three or four children.

The general washing is done on the premises, but all the articles are steeped in perchloride of mercury solution before being laundried, which method shortens their period of usefulness very considerably.

Medicines and dressings are kept in a dispensary.

Segregation of patients suffering from the disease is compulsory, both in the Canal Zone and in the Republic.

The patients have small gardens, grow corn and flowers, fish, keep fowls, &c., barter among themselves, and the Superintendent buys eggs from them for use in the institution.

The inmates, comprising people of many races and colours, are at present forty in number, and expenses are met by an Appropriation Fund from the Canal Votes.

The cost of food and attendance works out at \$1 a head per diem ; the clothing, however, which is provided is extra.

Habana.—Las Animas Hospital.

40. This is an infectious diseases hospital and is situated on the top of a hill near the outskirts of the town where the stegomyia has never been found.

The main building, consisting of numerous small wards, is on one floor, and was originally an old mansion. It has been made thoroughly mosquito-proof with 16-mesh copper gauze, which Dr. Guiteras considers small enough to keep out any mosquito.

The wards, containing 3–6 beds each, are on both sides of a long corridor, and in the newer part are arranged alternately on each side.

Occasionally, when advisable, a whole family is taken into hospital, although only one may be suffering from the disease, and in many cases a mother comes with her child. Nursing is done by white nurses.

There is a laboratory, in a building by itself, in connection with the hospital, and this is where the early yellow fever experiments were made, and where the original jar and mosquito netting used in those experiments are still kept.

Society Hospitals.

41. There are four large and two small "Society" hospitals in the town, which are kept up by the various organisations of which the largest are the Asturians, Dependentes (Clerks), and Galicians. They are very wealthy institutions. The members pay regular subscriptions and have free treatment as in or out patients when necessary.

The hospital of the Society of Galicians is situated in large, pretty grounds and is built on the pavilion principle. Most of the buildings are on one floor only, but a few have two.

There are both large and small wards, some of the pavilions being divided up into numerous small rooms. Each bed has a mosquito net for hanging over at night.

There are only two white nurses in charge, the real nursing being done by attendants, who have had no special training.

One building had been erected for treatment by the various kinds of baths, and also contains a swimming bath. Another is devoted to X-ray and laboratory work, a third is for cases admitted for fever of any kind, and in a fourth there are only tubercular cases.

These institutions are very wealthy, and almost seek outlets for expenditure of their money.

University Hospital.

42. This is supported by Government funds only, is situated close to the sea, and has a medical and a nursing school attached.

It is a one-storey building. The wards are painted white, are clean, light, and airy, and built off a long corridor on each side alternately. One ward is for lying-in patients only.

The nursing is done by white nurses, and appears much more satisfactory than in the Society hospitals.

When a patient is admitted his clothes are all listed and disinfected, and carefully parcelled and stored.

All the milk used is pasteurized.

Jamaica : Kingston Hospital.

43. This hospital, which has a bacteriologist attached, does not require special remark, but I should like to draw attention to the fact that it is supplied with dark rooms fitted for eye examinations and photographic work in connection with the X-ray apparatus, and that all fresh food-stuffs, meat, vegetables, &c., immediately on delivery at the

hospital are placed in a mosquito-proof room in connection with the kitchen, prepared there for cooking, and not removed till put on the stove.

Lunatic Asylum.

44. This is a large institution situated outside the town in large grounds with a long sea frontage, under the care of Dr. Williams, to whom I am indebted for the following facts :— It has 1,200 inmates, and is nearly all new, as the earthquake destroyed much of the previous one.

The new part is of brick, mostly on one floor. The female portion is built in the form of quadrangles with buildings having a verandah running round on the inside on two or three sides. There are many single rooms, but others are larger, and contain several beds.

All the patients have beds which consist of a heavy framework, and canvas, with eyelet holes to fix over nails on outside of frame, is stretched across ; these are all taken out and washed in sea water every week.

The small rooms have a very free current of air through them, as at both back and front is an opening about 7 feet by 3 feet with iron bars only. One is a doorway.

The female mess room is simply a large covered shed without walls.

Two new buildings have just been put up for male patients, each with two floors ; these have lofty light wards, and are painted white inside. Half the wall space is taken up with barred windows with lattice shutters, which can be closed if required. These wards are at one end divided into compartments for single patients by thick wood pailings (2 inches by 4 inches), with rounded edges, going up to the ceiling with 3 inch intervals between them.

There is a special ward for those patients suffering from tuberculosis.

The male mess room is the covered-in interval between the two new buildings, and is quite open at each end.

All patients have a spray bath every morning.

Trough closets with automatic flushing arrangements are being put in.

Dr. Williams informs me that with the adequate bed clothing supplied, the free ventilation gives better health than in the old buildings, and leads to no complications.

A theatre or concert room, which on Sundays is used as a church, has been erected, and a large area for recreation is provided in the grounds.

The attendants number one to every 12 or 15 patients, and the maintenance rate is ten pence per diem per patient.

I have given a fuller description of this institution than was really necessary on account of the objection always raised on the coast to adequate ventilation, which is held to "cause" pneumonia, chills, fever, &c., and with which on this point our institutions compare unfavourably.

Prison.

45. I mention this institution in order to bring forward the fact that the compartment in which all the baking and cooking arrangements are carried on is screened with mosquito gauze, and although a few insects get in, their number is very few indeed to that of those which desire admission.

GENERAL SANITATION AND ANTI-MALARIAL WORK.

Para.

46. Para is a large town and port on the river bank near the mouth of the Amazon River with a population (75,000–100,000) which is in parts very crowded together.

The temperature varies mostly between about 60 and 90 degrees F., and there is rain practically every day of the year.

47. *Streets.*—The streets, except in the outskirts, are all paved. They are narrow in the older and lower parts of the town, but in the newer are wider and open, and have rows of mango trees planted on each side. They are mostly kept in a good clean condition, but in the poorer parts this is not always the case. In the outskirts the main ones are quite 60 feet wide, but only a few are even partially paved, and most have only "cut" drains on each side. The cross roads are all grass covered.

The houses (residences) in the town proper are mostly one-storey buildings, and the better ones are all raised up off the ground, although the part underneath is often used during the heat of the day. In the outskirts are a number of mud houses with small compounds of a character very similar to those of Lagos.

48. *Water Supply.*—Water is supplied direct to the houses, the supply being brought to large iron tanks in the town which are situated at its highest part and raised to a considerable additional height on an iron framework, and from them is led to the service pipes. Water closets are fitted in all the houses. There is a system of sewers and drains in

and about the town which opens into the river lower down, and the usual daily flushing by rain water appears to be very advantageous.

49. *Refuse*.—The town refuse is collected daily in carts. These are two-wheeled vehicles drawn by horses, mules, or oxen, and are covered in by a front and a back lid which works on an axis across the middle.

In many places the rubbish is simply put into heaps along the sides of the streets which the carts collect and remove.

50. *Slaughter-house*.—The abattoir is situated on the river bank some little distance below the town, but unfortunately I was unable to visit it.

51. *Anti-mosquito work*.—Anti-mosquito work is carried on by the Commission (see *Anti-Yellow Fever Measures*), and some filling in operations are proceeding by means of a pump dredger.

When the scheme of making a long river wall, which is now in progress, is complete, it will lead to a great improvement in the present condition of the river bank, where many river steamers tie up, and which is at parts very bad.

MANAOS.

52. Manaos, which is not so old as Para, and is 800 miles higher up the river, is a town of 30,000 to 40,000 people, situated on the bank of the Rio Negre. There is a good deal of shipping, and some wharfage accommodation, but many of the small river boats simply tie up to the bank, stern on.

53. No meteorological record is kept. This was done at one time, but I understand the observations were discontinued as the observer ceased to receive his emoluments.

54. *Streets, houses, &c.*—The streets in the town are paved, but in many parts the stones have not been laid with sufficient foundation to stand the weight of the traffic. The main one is wide, but the majority, however, are only of moderate width, and a few are narrow, but these are not so bad as some in Para. All are cleaned up daily.

There are several open squares, which are under the care of the municipal authorities.

The houses are brick built and plastered in most cases, and in the main parts have several stories, but outside this only a few have more than one floor.

In the low parts of the town there are plenty of houses on swampy ground ; some, with their compounds, very much

resemble those in Lagos with a decent building in the front and many small filthy shanties behind.

Several guarapés or swampy streams or side waters in connection with the river run up into the town, and attempts are being made to fill up some, but the regulations issued as to what material is to be used are not always adhered to.

Even in the main parts of the town very dirty places with much refuse or filthy drains can be easily found.

When the river wall is completed and properly filled in behind it will greatly improve the sanitary conditions on the river bank.

In the outskirts the roads become much worse, are not paved, and in many instances are at present simply tram tracks. They are, however, cut wide, and will become fine avenues in the future.

The compounds in very many cases are not kept clean, and the grass in the roads covers a good deal of rubbish.

54. *Emigration to outskirts.*—The tram service which has been instituted has led to many people living away from the town itself, and the number of these is rapidly increasing. Many of the houses put up are made of mud and stone or wattle, the better ones of this class being covered with cement, and having cement floors. The roofs are either tiles, galvanized iron, or palm thatch. A few substantial residences have also been built. The people have thus shown themselves willing to leave the centre of the town if suitable means of access to it be provided.

55. *Water supply.*—The water supply is in the hands of a company, and is laid on to all houses. It is, however, intermittent, which necessitates the presence of cisterns and other containers in the houses. The meter system is to be introduced on account of the great waste. The old source of supply was a stream about two miles from the town, where a dam was built and the collected water pumped to a service reservoir close at hand.

The supply is now obtained from the Rio Negre, about three miles above the town, whence it is pumped into a tank. The water obtained is brownish in colour.

The pumping station contains two powerful pumps, which work alternately, each being capable of drawing up $2\frac{1}{2}$ million gallons a day. The inlet to the pipe is situated 100 metres from the bank, and two metres below low-water level (river level varies 50 feet).

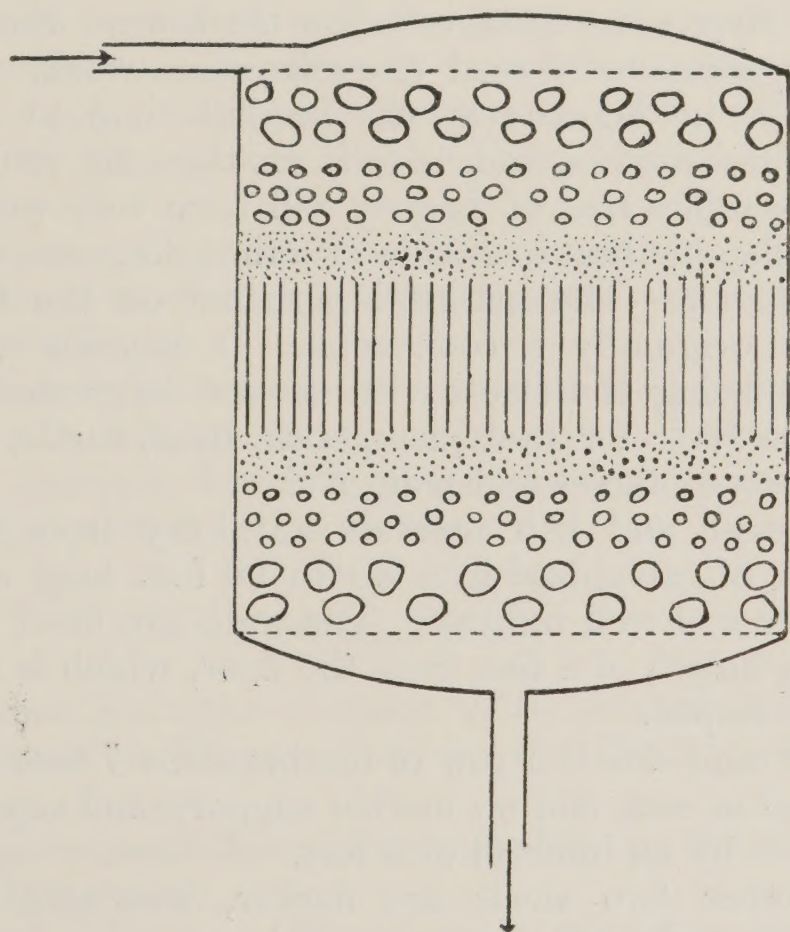
The water is pumped into a 3,000 gallon elevated iron tank, and from there flows to the filters, which it enters with a 30 feet head of pressure. After leaving the filters it is

pumped along two 12-inch pipes to a large elevated tank reservoir situated in a high position on the outskirts of the town whence it is issued to the service pipes.

The filters are 10 in number, and consist of iron cylinders 12 feet in diameter and 12 feet high. The filtering material consists of gravel, sand, and pulverite, arranged in layers and kept in position by large plates above and below, which are perforated all over to allow the water to pass through evenly at all parts.

From above downwards the layers in the filter consist of :—

1. Perforated plate.
2. Gravel stones, $\frac{1}{2}$ -inch to 1-inch diameter.
3. Smaller stones.
4. Sand.
5. Pulverite, 2 feet thick.
6. Sand.
7. Small gravel.
8. Gravel stones, $\frac{1}{2}$ inch to 1 inch.
9. Perforated plate.



Each filter is cleaned every two days (after which period hardly any water will pass through) by passing a stream of water in a reverse direction for a couple of hours. As far as I could ascertain there is no systematic examination of the

water supply. The filters have been in use for three years without opening. The water issuing from the filters has a brownish tinge, but I was told that if the filtering be done slowly it becomes quite clear.

The amount of water issuing from the pumping station shows a supply of 60 gallons per head, but there is a very large amount of waste. The expense for 75,000,000 gallons per month is £1,000.

One Englishman is at present in charge of the station, and with him are Portuguese workmen.

56. *Sewage arrangements*.—There is a water closet system for all houses of any size, and the town has definite drainage and sewage arrangements which open into the river opposite the town. It is said that all cess-pits and privies have been done away with.

57. *Rubbish and refuse*.—Rubbish, refuse, &c., is placed in receptacles by the householder, and these are placed at the side of the streets at night. Merchant houses can put them out between 5 and 6 p.m., but private houses not before 8 p.m. Carts go round in the night, collect the refuse from these receptacles, and remove it to lighters which are emptied into the river some distance below the town. Some portion, however, seems to be used in reclamation work. There is a gentleman in Manaus at the present time to erect some Horsfall destructors, and he tells me that the refuse (which much resembles that of Lagos) will burn very well and give off considerable heat available for other purposes.

58. *Market*.—The market is situated on the river bank, and was originally a concession. It consists of a brick building facing the street with several large sheds between it and the river for meat, fish, pork, liver, turtle, &c., and a fourth for vegetables and fruit, &c.

The meat and fish markets are lofty iron frame-work erections, of galvanized iron 80 to 90 feet long and 30 feet wide, airy and well lighted. The walls are lined with white tiles to a height of 8 feet from the floor, which is of concrete properly sloped.

Down each side is a row of marble slabs 7 feet by $2\frac{1}{2}$ feet supported at each end on marble supports and separated from each other by an interval of 2 feet.

The other two sheds are darker, less airy, with less ventilation and much more crowded.

Each stall has a small thick wooden table for chopping on. Behind the slabs nearer the wall is an iron rod, aluminium painted, and supported on pillars, on which moveable hooks are placed.

The stalls are let off at fixed rentals.

In the vegetable market there is a duty on all articles sold (note is taken of all goods taken in and all removed), *e.g.*, duty on one pineapple is 1½d.

59. *Butchers*.—Butchers have all to be licensed.

Meat is killed in an afternoon at the slaughter-house outside the town and sold next day. A few butchers have their shops in the town, but they are compelled to have tarred walls, cement floors, and marble slabs (in one piece).

60. *Market gardens*.—There are a number of market gardens about the town, especially around the swampy parts, and the owners have all received notice to remove them to places beyond the outskirts.

61. *Building*.—No alterations, even of a very minor character, can be made to houses without authorisation, and the owner of an empty plot of land facing a street, if he cannot build a house, is compelled to put up the front of one.

62. *Cuspidors*.—On account of the habits of the people cuspidors are placed in all public buildings, but do not receive the amount of attention which might with advantage be given them in preference to the floors and ground.

63. *Vaccination*.—Vaccination is not compulsory, and is not much done. Although there have been epidemics of small pox at other places on the river, Manaos has so far escaped.

64. *Leprosy*.—There are a number of patients going about suffering from this disease, no measures for segregation having been adopted.

65. *Anti-malarial work*.—See *Anti-yellow fever measures*.

Dr. Thomas informs me that although a good deal has been done, mosquito breeding-places can yet be found in a very large proportion of the houses.

Panama Town.

66. Panama is a town of about 2,500 houses and 40,000 people, situated on Panama Bay, on the Pacific side of the isthmus.

Vast improvements have been made here by the Americans in the last few years.

67. *Streets*.—In the oldest parts of the town the streets are narrow and shut in, as the buildings, which are of brick or stone, are three to four stories high. In the new part the streets have been laid out of a suitable size, and the buildings are mostly of wood. The streets in the town proper are

paved with "vitrified" brick, which, although somewhat expensive in the first instance, is lasting and easily cleaned and washed.

68. *Water supply*.—The water supply has been arranged by the Commission from the Rio Grande. A reservoir (Rio Grande Reservoir) was made in the hills and water brought by a 16-inch pipe to a cement service reservoir on Ancon Hill, just outside the town. As the pressure thus obtained was insufficient to supply the Canal Commission Houses on the Hill, an elevated iron tank was erected in a more satisfactory situation and water is pumped to it from the cement reservoir for issue to houses in these parts.

A proper water installation with modern plumbing is compulsory in every house, and water is charged for by meter.

69. *Sewage, &c.*—Cesspools are nearly all done away with, and a properly installed water closet is an essential in every house and must be put in. In tenement houses there must be a suitable wash-down water closet for every eight rooms or one for every 15 people, and it is found better for cleanliness sake if there be no wooden seat over the thick porcelain rim.

A system of sewers takes all the sewage from the water closets and trap drains in the town and conducts it into the sea. There is also a system of surface drainage which receives all rain water and that portion of drain water which does not enter the trapped drain, and leads it into the sea.

70. *Rubbish*.—Rubbish, refuse, &c., is collected by each householder in a special container supplied by the authorities, but which he has to provide himself with at his own expense. Collecting carts go round during the night, empty the tins, and remove the refuse to a swamp just outside the town close to the sea shore, where it is dumped and kept continually burning.

71. *Refuse cans*.—The refuse cans are specially got out by the Government, and are in three sizes, the cost varying from \$1.90 to \$2.75. They are circular cans made in one piece of 22 gauge steel with heavy steel bands round the top and bottom, and vertical strips of triple angle iron at intervals down the side. The lids are convex and project $\frac{1}{2}$ inch all round the edge. In some instances, as in the poorer quarters of the town, a wooden lid, as used sometimes in the Canal Zone, is more useful, especially as the lids are often lost. These tins stand a great deal of knocking about and are very durable. Dr. Perry kindly furnished me with a copy of their specification.

72. *Market*.—The market is a large, partially closed-in shed with a galvanized iron roof, close to the sea shore, in fact, part of it is on pillars over the beach. This latter portion has a wood floor, that of the remainder being concrete. In this market are sold vegetables, fruit, meat, fish, and live stock, fowls, &c., the portion over the water being allotted to the last.

The meat market is not mosquito-proof, and the butchers' stalls are all wood. A new market is to be erected.

73. *Slaughter-house*.—The slaughter-houses are situated close to the water's edge. They consist of two galvanized iron roof sheds with walls 3 to 4 feet high, and are divided up by partition walls of cement into compartments about 8 feet by 6 feet.

The floors are concrete and sloped; one shed is for cattle the other for pigs.

There is another shed alongside where the cattle are brought and temporarily kept. Animals are slaughtered early in the morning, and the meat is all sold during the day.

74. *Butchers*.—All butchers have to be licensed.

75. *Infectious disease*.—Any cases of infectious disease occurring in the town are at once removed to the isolation wards in the Ancon Hospital, and the necessary steps taken.

76. *Lepers*.—Lepers are compulsorily segregated. (See Leper Asylum).

77. *Buildings*.—All the old buildings are gradually being pulled down and replaced or else renovated to meet modern requirements. No building can be erected without permission, nor can one be put up outside the sanitary area (water and sewage).

Land must be brought to proper level before commencing work. No roof gutters are allowed. Where in a renovation gutters are deemed advisable they must be

1. Properly sloped.

2. Supported at intervals of 20 inches to 24 inches by suitable supports.

3. Down pipes must be provided every 20 feet.

Adjoining houses must either have a common partition wall or be separated by an interval of at least 3 feet, and the ground between sloped with concrete, $1\frac{1}{2}$ feet to be done by owner of each side.

Roof must be so constructed that all water from it falls into the street, yard, or cemented passage way. The yard must be cemented, and have a trapped drain leading to the sewer. A sink must be placed in each yard.

The floors of houses must be of concrete 4 inches thick with $\frac{1}{2}$ inch good cement facing (the few wooden ones remaining in the town are being gradually got rid of) or else must be raised 3 feet above the ground. Preferably the former. If wood is placed over a cement floor there must be no interval between.

Satisfactory sanitary and plumbing arrangements must be installed.

If the wood wall in a house is double, the interval between the two layers must be filled with concrete for 8 inches above the floor.

The Sanitary Inspector watches a building being put up, and if it is not being erected according to the permit, he can stop the work and report to the Medical Officer of Health.

A copy of a permit issued :—

1. No roof gutters.
2. The building to be connected with the water and sewer systems and modern plumbing to be installed.
3. Floor of house and yard to be concreted 4 inches thick with $\frac{1}{2}$ inch facing of good cement (cement 1 and sand 2).
4. One window to be placed in each room in best position for ventilation.
5. Roof to be made so that all water falls into the yard or street.
6. Land to be brought to proper grade before construction of building be begun.
7. Front and sides of house to be flush with the street, but rear and sides not to be nearer than $1\frac{1}{2}$ feet to lot lines, if not on street.
8. Plans and permit to be kept on the work during working hours, and to be accessible to representative of Medical Officer of Health, who has power to stop work on the building if conditions are being violated.

78. *Sanitary notices.*—When the Medical Officer of Health wishes alterations made or condemned buildings to be vacated he gives the occupants verbal notice. If after a reasonable time nothing is done he complains to the Alcalde, who gives the necessary order.

If after another reasonable interval, conditions still remain the same, the Alcalde fines the owner in the former case, and in the latter men go and render the house uninhabitable or pull it down.

If a nuisance be found on a premises notice is given and a time fixed in which to remedy the condition. After

expiration of time given, another inspector (not the same one) visits and reports. If necessary the Medical Officer of Health recommends Alcalde to fine.

79. *Decrees.*—In changes which may affect many citizens, public decrees are issued, *e.g.*, one has been published recently, viz., that all houses without adequate drainage or water supply will be closed after April 30th.

80. *Staff.*—The Medical Officer of Health, besides the necessary staff of clerks, has working under his direction :—

6 white inspectors paid not less than £15 per month each, who inspect every part of the town twice a month, and some parts more frequently.

15 ditching men.

5 cesspool men (mostly used for other purposes now).

15 general utility men for fumigating and general purposes.

An inspector and assistant for anti-mosquito work, with two oiling carts.

81. *Records of Houses.*—For each house in the town there is a card in the Sanitary Office giving particulars about it and showing dates on which it has been inspected and its condition, if nuisance, when remedied, &c. Inspectors send in reports every morning of their previous day's work, and these are entered up on the cards by the clerks.

82. *Stables.*—Stables must all have floors of concrete, a trapped drain, and be kept properly cleaned.

83. *Bakeries.*—Bakeries are inspected and reported on.

Colon.

84. Colon has a population of 15,000 to 20,000, and is situated on the Atlantic side of the isthmus. The land on which it is built belongs to the Panama Railway Company and is only let on strict leases.

Nearly all the buildings are of wood.

The town is on an island, only connected with the mainland for railway purposes, which in parts is very low and swampy, the highest point, in fact, being only 8 feet above the sea level.

85. *Streets.*—The streets are wide, clean, and at right angles to each other. They vary in width from 20-150 feet (only the old ones are 20 feet) with 10 feet side-walks, the majority being 40-60 feet wide with side-walks on each side. Those near the sea front are paved with vitrified bricks, the others being macadamized. The bricks cost 2 c. (1d.) each

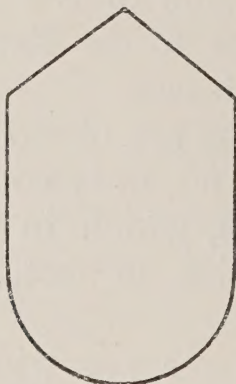
landed. They are laid on a cement foundation and liquid cement is poured into the spaces between them. The cost of pavement with them is about \$5 a yard, but the money is considered well spent. Wide streets are specially desirable in these wood-built towns on account of fire, and Dr. Connor, the Medical Officer of Health, tells me he would like to have them all 150 feet wide.

86. *Water Supply*.—The water supply has been arranged by the Government and its instalment in every house is compulsory. It is obtained from rivers in the hills where reservoirs have been made by means of dams.

87. *Sewers*.—Every house is compelled to have a properly fitted water closet. There is a regular sewage system into which all the water closets and trapped drains open. The sewer opens into a sump in the town. This is a large tank which will hold 40,000 gallons. Above this tank, the roof of which is 12 feet below the surface of the ground, is a chamber in which are two electrically worked pumps, each of which is capable of pumping 2,500 gallons a minute. They cannot both be worked at the same time and are only run as required. Rate of inflow of sewage varies, but in the morning is about 1,000 gallons a minute. Plan of pumping station with which I was supplied is attached.

From the tank the sewage is pumped about 3,000 feet along a pipe to the sea edge (piping gave out) but is to be conducted well into the water. The pumps cost \$2,500 each, and the total cost of putting in the tank and pumps, with the cost of pumps, was about \$20,000 or £4,000.

88. *Drainage*.—There is a large drain, 2,000 yards long, running along a broad street across the island and opening into the sea at each end. It is 6 or 7 feet in diameter and shaped as shown.



The drain is highest midway across the island and falls each way to the sea.

At intervals there are large inspection chambers, and opening into these are the earthenware pipes bringing

drainage from the side streets. Highest point of the main drain is 8 feet and is just below the surface. At low water the main drain empties into the sea, but at high water (only 18 inches) the latter runs up the pipe for a short distance. The surface drainage from the houses going towards the street runs either along a depression on the surface of the pavement or along a pipe underneath it to the drain at its edge.

Around each block of buildings in the side streets is a cement open drain which receives the surface drainage from the houses and yards. This gradually slopes to one corner of the block, where it opens into a branch drain and then into an inspection chamber and the main drain.

89. *Rubbish, &c.*—Each householder has to provide himself with a rubbish can of the approved type similar to the one used at Panama, but with cross strengtheners under the bottom which run up the side for 6 inches and very considerably increase the durability. Each can has to be placed on a wood frame stand. The can has a wood lid hinged on the stand and so fitted that it must be down unless held up.

The refuse is collected from these cans in uncovered carts, the latest of which will hold three cubic yards and has a moveable bottom which facilitates emptying, and is carried to a large swamp at the back of the town where it is dumped and kept continually burning. In this way the ground level is being gradually raised.

90. *Swamp.*—Between the back of the town and the sea (about half a mile) is a large swamp which is gradually being filled in by refuse as above. In addition, a suction dredger is pumping in muddy water. The swamp itself had previously been carefully surveyed and open ditches cut in various selected situations and directions to assist drainage, and into these the tide flows freely.

91. *Market.*—The market is a large square shed in the centre of the town with ventilated roof of galvanized iron and with palings along the sides. One portion is screened off (mosquito gauze with wire mesh netting on each side) for the sale of meat. Each meat stall has a marble cover 6 to 8 feet long on wooden supports and a wooden chopping block.

92. *Stables.*—Stables have been put up outside the town by the Panama Railway and are let at nominal rents. They all have cement floors and the stalls are covered with moveable boards to allow of removal for washing and cleaning. Drains take all the fluids and washings into the

swamp and thence into the sea. No horses, mules, &c., are allowed to remain in the town at night.

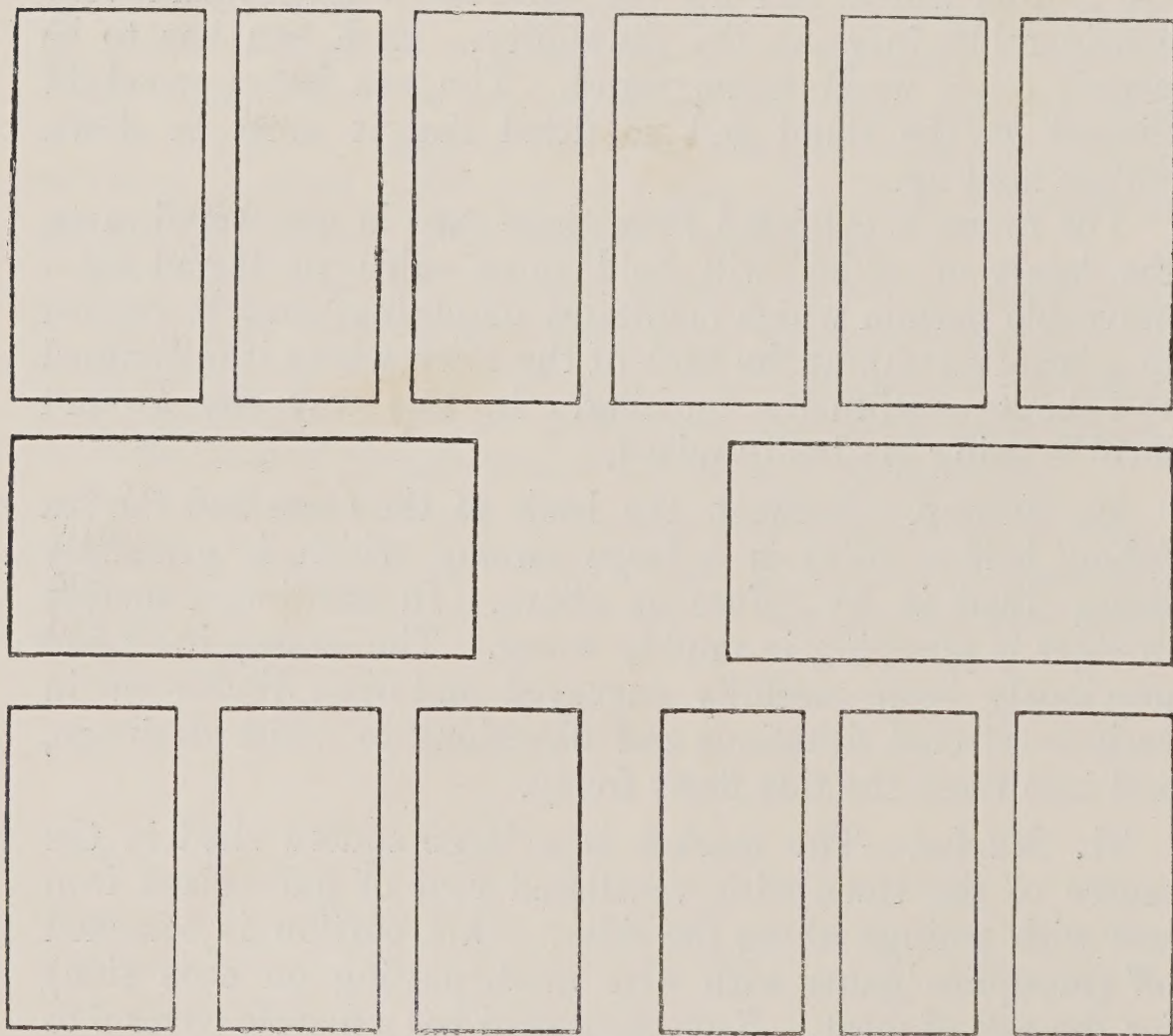
93. *Buildings*.—The building arrangements are very similar to those at Panama, but stricter, as there is more control, the land being railway land and only let on short leases. The cement pavements at the front and sides have to be put in by the owner.

The 3 feet interval between the houses must not be encroached on by verandahs. The interval is too small, and in many cases the builders have left a larger one and put a verandah on the upper floor.

The yard in connection with a house must be one-tenth of the total area.

Street.

Pavement.



Pavement.

Street.

In future buildings the blocks are to be shown in accompanying diagram with the sewage from all the houses running

into a central alley way and then into the sewer. By this arrangement it will be possible to remove any obstructions without interfering with the streets.

Cuba.

94. Cuba is an island with a population of 2-3 millions.

Habana, which is the capital, has 300,000 inhabitants.

All the sanitary work is under the direction of Dr. Guiteras, and, for convenience, the island is divided into districts each in charge of a medical officer with the necessary staff.

The annual sanitary budget amounts to £250,000, from which amounts are allotted to the different divisions.

Inspections of all premises in the towns and districts are regularly made, and, as evidence of the work done, Dr. Guiteras informed me that in 290,000 inspections of premises mosquito breeding-places were only found on 900 occasions.

95. *Death-Rate of Children.*—Dr. Guiteras considers it very important from a yellow fever standpoint to watch the rate of mortality in young children, and if from any cause there is a sudden rise in the death-rate, careful investigations are made by a medical officer.

96. There is a good deal of tubercular disease on the island and some of the hospitals have special wards for this class of patient.

97. *Habana.*—Habana is a large city and seaport. In the old parts of the town the streets are narrow and vehicles are not allowed to turn round even if they can. In the newer parts the streets are wide and there are many fine buildings.

All the streets in and around the centre are paved. With the increasing facilities of transport, electric tams, &c., the town is rapidly extending.

98. *Water Supply.*—The water supply is obtained from springs away from the town and is said to be of very good quality. It is laid on to every house.

99. *Sewage.*—The town has a regular sewage system, but improvements in it are being made, and in many parts the streets are in a very disturbed condition. It empties into the sea.

100. *Infectious Diseases.*—All cases of infectious disease are, if necessary, removed to the Las Animas Hospital, and, if considered advisable, the whole family is taken as well.

Leprosy.—The Leper Hospital is situated in the town itself, but is shortly to be moved to a more suitable spot. It

is an old whitewashed brick or stone building and is in a poor condition.

At present it houses 100 patients.

All leprous patients who cannot be isolated or looked after in their own homes to the satisfaction of the Health Officer are compelled to go to the hospital.

Yellow Fever.—There is no yellow fever now in Cuba. The last outbreak, which resulted in several cases being notified, was traced to an infected person arriving from New Orleans.

Typhoid Fever is present in the town, cases arising occasionally.

101. *Laboratory.*—At the Las Animas Hospital is a laboratory, where can be seen the original jar and mosquito netting used in the early yellow fever inoculation experiments with mosquitoes.

Here are kept a regular supply of mosquitoes and also *Pulex cheopis*. The pulices are in an open glass jar, about 9 inches to 10 inches deep and 6 inches in diameter, which has some sand in the bottom. They are fed by putting a mouse in occasionally. After feeding, the mouse is chloroformed and the fleas leave it or get to the end of the tail, from which they are easily shaken.

The various serums required are made here.

Outside the town is a station where is prepared the calf lymph used for vaccination. This is used for all vaccinations at home and a good deal is also exported.

102. *Fever Patients.*—All Europeans of the less wealthy class are members of the various club hospitals, and as treatment is free to them they seek advice at once if ill. These comprise the large majority of the “non-immunes” to yellow fever, and thus any case of “fever” occurring among them is seen practically at once.

All patients with fever from whatever cause are placed, on admission to hospital, in a mosquito-proof room or ward. These wards are visited daily by the Health Officer of the Town. If a case, after inspection, arouses no suspicion of yellow fever it is removed to a general ward, but should it do so it is immediately isolated in another mosquito-proof room. The Commission (consisting of the most experienced men in the town, and specially appointed for this purpose) is then summoned, visits the patient, and a definite diagnosis is made.

103. *Inspection and Anti-Mosquito Work.* — The town itself is divided into sections, each of which is thoroughly gone through once a month ; some parts, however, are visited much more frequently, according to requirements.

There are oiling parties which go out destroying all mosquito-breeding places and oiling pools, &c., &c.

In some of the low-lying swampy parts drains are cut, the edges of which are carefully looked after and kept clean and clear of vegetation, and the surface of the water is kept oiled. As a result of the careful work done, hardly any mosquitoes are seen in the town. Very many persons never use a mosquito net, and there is very little malaria.

104. *Dr. Guiteras.*—As a result of many experiments, Dr. Guiteras considers that 16-mesh mosquito gauze will keep out all mosquitoes, and he always uses that made of copper wire. In reference to the transmission of the yellow fever germ through the ova of the mosquito, he expressed strong doubts as to its occurrence.

Panama Canal Zone.

105. The Canal Zone is about 45 miles long and is divided for sanitary work into three divisions and 18 sections.

A white sanitary inspector is in charge of each section, a divisional inspector of each division, and a chief sanitary officer is in charge of the whole under the direction of Colonel Gorgas.

Each sanitary inspector, who is supplied with a type-writing machine, sends in, among others, a weekly report showing the number of men employed on his section, number of cases of malarial fever per 1,000, number of mosquitoes caught, &c. These reports are compared, a list is made with the section with the smallest malaria rate at the head. Competition is thus aroused among the inspectors, each one desiring to see his section heading the list.

Stations have been made at various places along the line of Canal where the work rendered it necessary that people should live, and round the more important and permanent of these towns have sprung up of considerable size.

106. *Statistics.*—When the death rate and other statistics of the earlier years of construction are compared with those of to-day, it will at once be seen what an enormous change has been brought about, and when, in addition, it is considered that the scourge of yellow fever has been completely

got rid of, the grand return which has been obtained for the money expended on sanitary work is at once appreciated.

	1906.	1910.
Death Rate	41·73	10·98
Death rate of Americans from disease— (Men, women, and children) ...	—	3·64
Deaths from Dysentery	69	21
„ „ Malaria	233	50
Admission rate into hospital for malaria per 1,000	821	187
Death rate in Canal Zone, Panama, and Colon	48·3	21·18

107. *Climate*.—As far as I could judge from my short stay the heat is not so great nor so trying as that in West Africa.

There are two seasons, a wet and a dry, and on account of the great amount of moisture and want of the regular breeze of the dry season, the former is the more trying.

Everyone wears straw hats of one kind or another, and a sun-helmet is more or less of a curiosity. This I noticed to be the case everywhere I went. Only in British Colonies were they to be seen occasionally and looked upon as an ordinary form of headgear.

108. *Alcohol*.—No trade in alcoholic liquor is allowed in the Canal Zone. Iced water, which is supplied on all trains and in other places, is the main form of liquid refreshment, and at meals iced water or iced tea are the chief beverages.

109. *Wives and Families*.—The men are encouraged to bring their wives and families out with them. House, light, fuel, and education are provided free, with medical attendance free, and hospital treatment at nominal rates, unless special accommodation is desired. Very many have done so, and a point which strikes one very forcibly, is the very healthy appearance of the white population, men, women, and children, many of the last being quite robust and ruddy.

110. *Quarters*.—The Commission houses all employés, gold and silver—which is almost equivalent to white and black—rent free if they wish, but some of the coloured people prefer to live in their own places. Some of the bungalows are occupied by one family only, while others are divided up to accommodate three or four. Unmarried men mostly occupy rooms in larger buildings.

The Canal houses are all built of wood, on the bungalow pattern, with one, two, or three storeys, the vast majority having verandahs all round.

They are raised 3 feet off the ground at its nearest part, but as this is not levelled up it may be much further away at other parts.

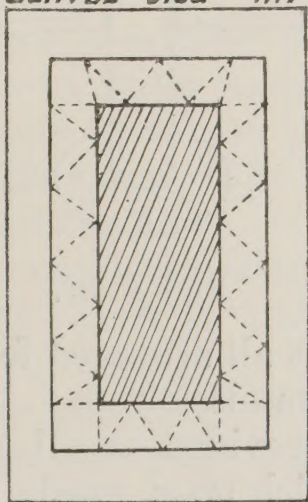
The wooden supports are usually in or on cement or brick foundations. The roofs are of galvanized iron without any guttering (none being permitted) and are painted black, the houses themselves being of a dark blue-grey colour. The inside of the rooms is generally white. Every bungalow is made mosquito-proof on the outer edge of verandah by gauze from roof to floor. The doors are single, all open outwards, and are fitted with strong special springs to keep them shut.

The Canal Commission houses have ventilators at the ridge and an interval between the top of the wall and the roof (only in a few of the old French houses, which were built with a view to shutting out the miasm, is the latter not present).

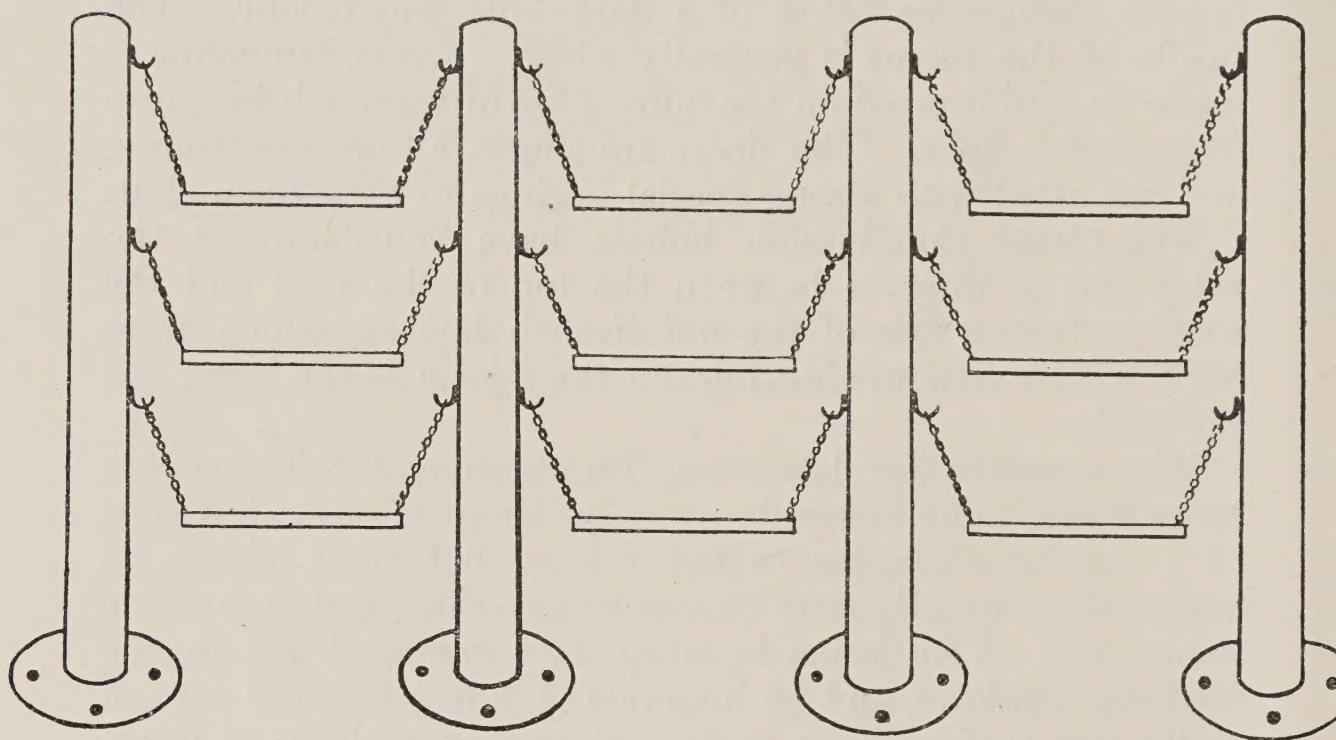
The quarters for labourers, European and coloured, are large single-room mosquito-proof buildings of bungalow type of a similar character to the others, but have either no verandah or usually only on one or two sides, and are on one floor only. Ventilation is adequately arranged for in the roof, by windows, and by intervals of 2 feet between tops of walls and roof. There is no ceiling nor is the roof lined. The inside is painted of a light colour, white being recommended. In some instances these houses are provided with double doors as an extra precaution, but the men do not always make proper use of them.

The sleeping accommodation is arranged in tiers. Each bed consists of canvas stretched out with thin rope on a metal frame which is painted white. These beds are put up in lines of which there are usually two in a house. Each line has two rows (one on each side of the supports) and each row has three tiers.

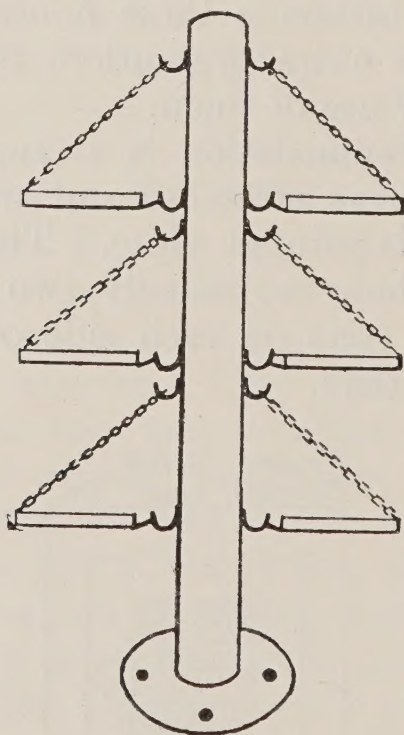
*Frame with
Canvas tied in.*



During the day the beds fold up towards the central supports so as simply to make two thin partitions in the room. The bed framework is easily removed from the central support, and once every week frame and canvas is taken outside, put in an iron tank, boiled, scrubbed, and then rinsed, dried, and returned.



Side View.



End View.

111. *Food*.—This is all arranged for by the Commissariat Department of the Commission.

Mess houses are provided at all stations for gold and silver employés at which good meals are supplied at a fixed

moderate rate. Married officers have their meals in their own houses but all others use the mess houses.

Stores, each having a refrigerator, are provided at each station for the use of employ  s only, who buy by coupon, no money being accepted. These stores are supplied from Colon (where all stores are landed) whence a train runs daily at 4 a.m. and delivers ice, meat, fish, vegetables, and general articles at each store along the line.

Bread is also made by the Commission bakery and supplied. Fresh food and vegetables can be obtained in the local markets.

112. *Markets*.—At the main stations markets have been built at which chiefly meat and vegetables are sold. These are large sheds with galvanized iron roofs and concrete floors, the sides being closed by wooden palings 6 to 8 feet high.

The parts set aside for the sale of meat have all been made mosquito-proof by wire gauze protected on each side by small mesh wire netting. The customers enter this part through the usual outward-opening door, make their purchases and go out again. This arrangement is very much appreciated both by the butchers and customers, and the enclosure is not close as might be anticipated.

The stalls are let at about \$2 a month.

All cleaning is done by Commission employ  s as it has been found to be the most satisfactory method.

113. *Laundry*.—The Commission arranges for the washing of household linen by providing a steam laundry to which it may be sent and where it is washed at a fixed rate.

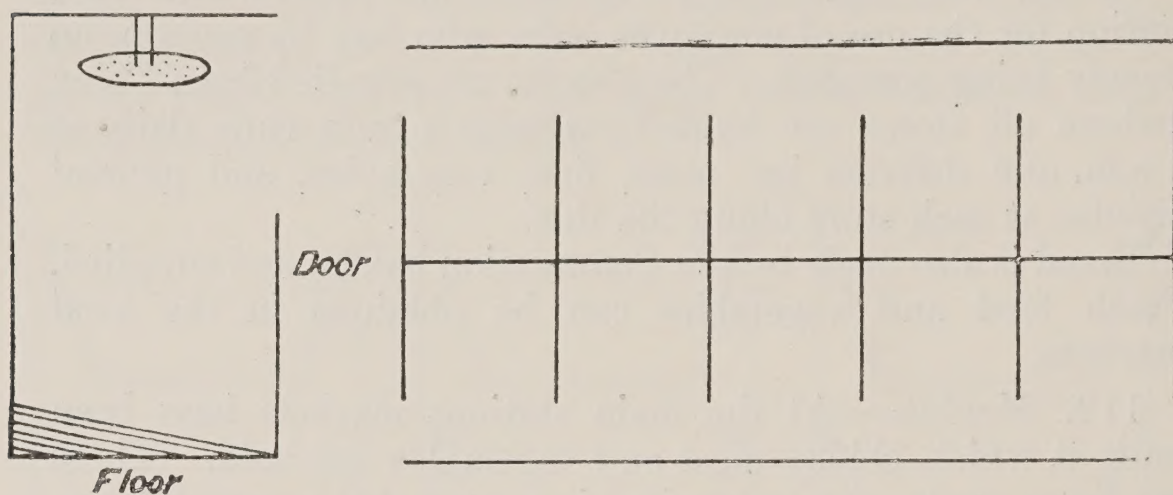
114. *Water Supply*.—There is a pipe-borne water supply at every place of any size, and nearly all places along the line. The Rio Grande reservoir supplies Panama and places at the west end of the Canal, and two other reservoirs on the eastern side of the watershed supply the places on the eastern part.

All houses of the Commission and all others, except those of such small size and poor condition into which it is not worth while to put it, have a water supply of their own, and for the remainder standpipes have been put up.

These are furnished with spring taps which when let go spring back so as to cut off the flow.

Bath-rooms, which are small compartments with a sloping cement floor and a spray fixed in the ceiling, are in all Commission houses, and in the case of labourers' dwellings, are in separate buildings which are divided up into these compartments. In connection with the very poor class of

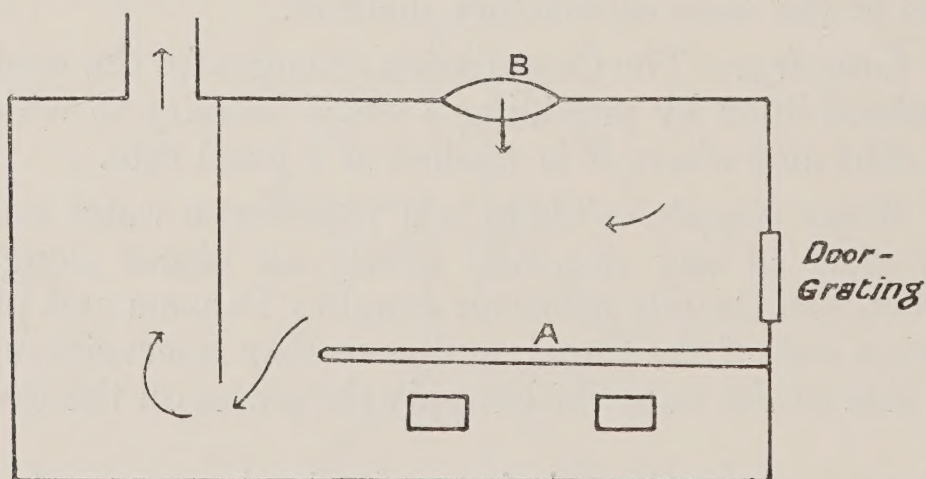
houses without a water supply wash-houses have been put up for common use.



Section of a Compartment.

115. *Rubbish and Refuse*.—Each house has to have a special receptacle for its refuse which is collected nightly, taken to the destructors, and burnt. The receptacles are similar to those used in Panama (see Panama Town). At some of the labourers' barracks the tins are put on a wooden stand, and instead of a metal lid they have a wooden one of a type similar to those mentioned under Latrines.

There are destructors at all the chief stations of the following type :—



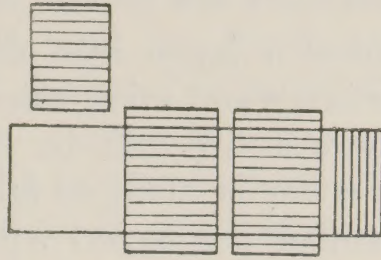
The fire is started by coal at A, and, when properly going, refuse is put in through B, and it goes on to burn itself. Draught enters through the door and grating and the chimney is long in order to increase it.

The old tins are collected from the remains and taken away and buried. In the dry season they are simply collected, and before the rains commence the large collection is removed and buried.

116. *Sewage*.—There is a sewage system at most of the stations with which every house, with the exception of those

mentioned above, must be connected. On the one side they open into Panama Bay, and on the other into the Chagres River, and at Colon into the sea.

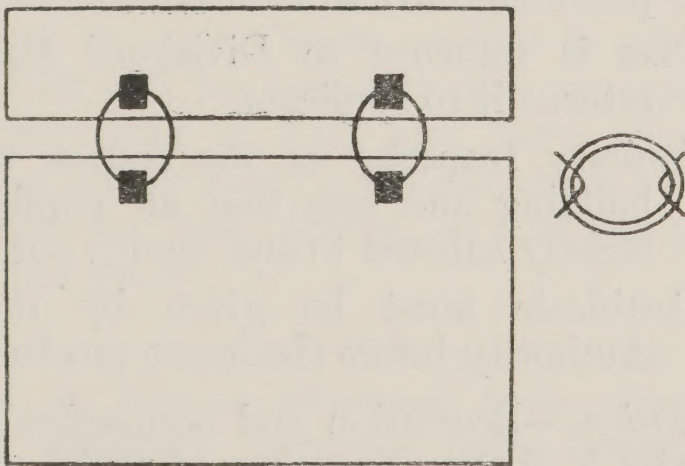
Every house except those of too small and poor a character, is compelled to have an approved closet properly installed.



Lids on trough.

For labourers' barracks and for the small and poor houses trough water closets with automatic flushing arrangements have been erected. They are not divided up into compartments. There are covers placed over the trough, one of which must be raised before the person can use it. A wooden bar behind the lid is so fixed that the lid cannot be raised to quite a vertical position and therefore automatically falls into its place when the person goes away. These covers are not supplied with hinges, which easily become bent and broken, and are expensive, but are jointed instead by two-inch rings fixed by a staple at each side.

These give an easy play and allow of greater adaptability of the wood to the surface edges of trough. They are cheap and can be easily repaired.



Where there are no sewers, and other arrangements have to be made, a hole is dug 8 feet deep, over which is placed a small wooden hut fitted with seat as a latrine, the cover being fixed as mentioned above.

These places are daily visited by the sanitary man and thoroughly sprayed with crude oil.

When the contents rise to a level three feet from the surface the hut is removed to a new hole and the old one is filled up.

In some instances the pail method with dry earth is used, the contents being emptied in holes and sprayed every day.

On the Gatun works there is a McCall incinerator in action.

Men sit on a seat over a large iron dish about $1\frac{1}{2}$ inches deep and deposit their faeces and micturate on it. Underneath the dish is a place where a fire can be lighted. When the dish is full enough, a cover is made to fall over the dish converting it into a chamber connected with a chimney. Fire is then placed underneath and the organic material is all burnt up, the fumes going up the chimney. This latrine had six to eight lots of two seats. When one or two lots were full they were burnt up while the others were in use.

117. *Buildings*.—If in Canal Zone a man wishes to build a house the following procedure must be gone through:—

- (1) Land must be leased from the Commission.
- (2) A fee of \$5 must be paid and plans of the proposed building submitted to the Divisional Engineer, who may either—
 1. Approve.
 2. Modify.
 3. Make a new one.
- (3) Approved plan is sent to the Sanitary Department which states what sanitary arrangements and plumbing have to be installed.
- (4) Plan is returned to Divisional Engineer who returns it to applicant.
- (5) Sanitary Inspector of the section watches the building and sees that all requirements are strictly adhered to and carried out.
- (6) Certificate must be given by the Sanitary Authority before the house can be occupied.

118. *Recreation*.—Recreation and occupation in evenings is catered for by Y.M.C.A., branches of which are in many of the stations, and ladies are admitted. These institutions have libraries, billiards, clubs for tennis, riding, cycling, reading, chess, &c. Entertainments are also arranged at intervals.

119. *Anti-Malarial Measures*. — Among the whites malaria affects chiefly the males of a family; females and

children often escape. Some women and children have been out two years without suffering from the disease.

120. *Clearing*.—All the undergrowth for a considerable distance, 200 yards round a settlement or group of houses, is cleared away (trees may be left if desirable). Ornamental bushes and creepers, when not on the ground, are allowed after the work is well in hand and results are being obtained. Around isolated houses the clearing must be done for 100 yards. Grass is grown on the cleared land and is kept short. It has never to be allowed above 6 inches in height, and not that, if possible, as it affords harbourage and protection for the insects.

Clearing is done where practicable by burning. The grass is sprayed with crude oil or oil and water, left to dry for a day or so and then burnt. If no water be used it can be burnt at once after spraying.

121. *Destruction of Mosquitoes*.—This method is adopted where other methods cannot be properly employed or where from some cause they have proved ineffectual.

The means employed are—

- (1) By a catcher.
- (2) By traps.
- (3) Destruction of larvæ.

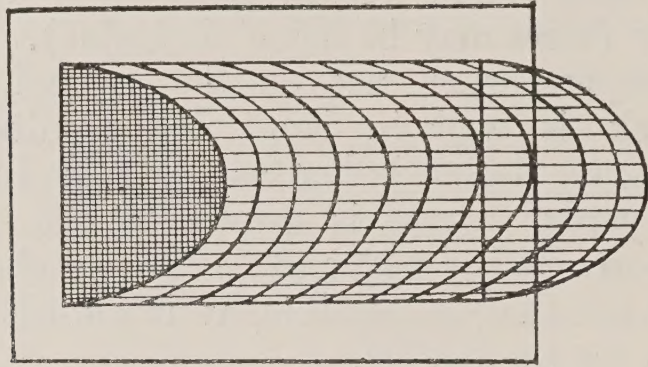
(1) Under varying conditions of weather, which are not quite understood, the mosquitoes in a room will all go to one part, and in every house around in which there are mosquitoes they will be found in the corresponding parts. There is a short time at dusk and dawn when mosquitoes inside a house try for about a quarter of an hour to get out and then give up their efforts to this end; later, those outside try and get in.

A man, who is supplied with a test tube with a little cotton wool at bottom saturated with chloroform, goes round each labourers' barracks, mess house, &c., every morning. This man does not visit private quarters except on request. The Sanitary Inspectors ask the occupants if they have any mosquitoes in their houses and if they would like the catcher to call. If they acquiesce, the latter is directed to go.

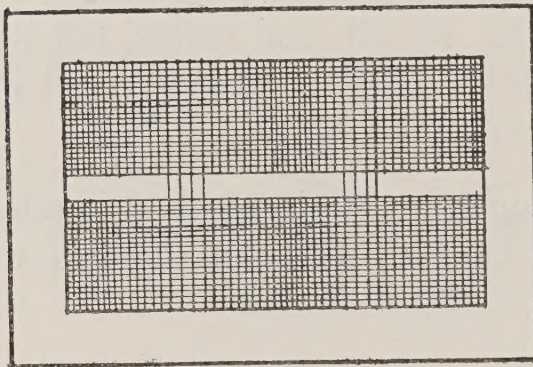
(2) *Mosquito Traps*.—These are usually placed in the

windows. They have been tried in floors and roofs, but in neither case with such good results as in the windows.

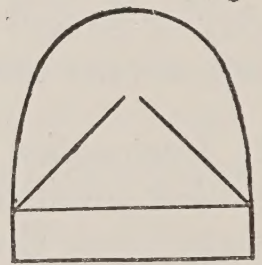
Trap.



Outer Cover.



Inner Gauze.



Section.

On a wooden rectangular frame a semi-circular piece of the wire gauze is fixed by its two ends, one to each side of the frame, and of such a length as to project six inches from the frame at its centre.

The ends are then closed with other pieces of gauze so as to make a chamber which can only be entered through the frame.

A second piece of gauze of the same width, but a little shorter, is doubled and a slit is made along the doubling line one-eighth to a quarter inch wide.

The edges of this are fixed above the edges of the other piece, and the double edges, where the slit was made, project into the previously made gauze chamber but do not reach its wall by one to two inches.

Mosquitoes enter through the slit, and experiment proves that only about 4 per cent. get out again even if left to die. The frame is carefully fitted into the window and every morning the mosquitoes caught are counted, classified, and destroyed.

Anopheles were very largely preponderant in the traps I saw in use. Observations are being made to compare the catch with the velocity and direction of wind, &c.

At Corosal there are two swamps each 1,000 yards away, one to leeward and one to windward, and the mosquitoes caught must come from one or the other. One swamp is to be thoroughly treated to prevent breeding and any difference in the catch in Corosal noted. If no difference is observed, the other one will be similarly done. If a difference is found the work will be stopped to see result and, later, done again.

122. *Breeding Places.* (3) *Destruction of Mosquito Larvæ.*

In looking for the anopheles larvæ, the quickest way is to stir up the mud with the hand and the larvæ then come to the surface, as, apparently, the mud interferes with their breathing.

The following are the methods adopted :—

- (1) Filling.
- (2) Draining.
- (3) Larvicides.

123.—(1) Filling is done where advisable and where possible, but it is generally expensive. The methods employed are dumping of solid material and the pumping in of water (thick muddy water) which gives a large sediment.

124.—(2) Draining :—

(a) Open drains.

(1) Concrete, 3 inches thick. These are made of various shapes, but the V shaped with a slight curve at the bottom instead of a point is the best.

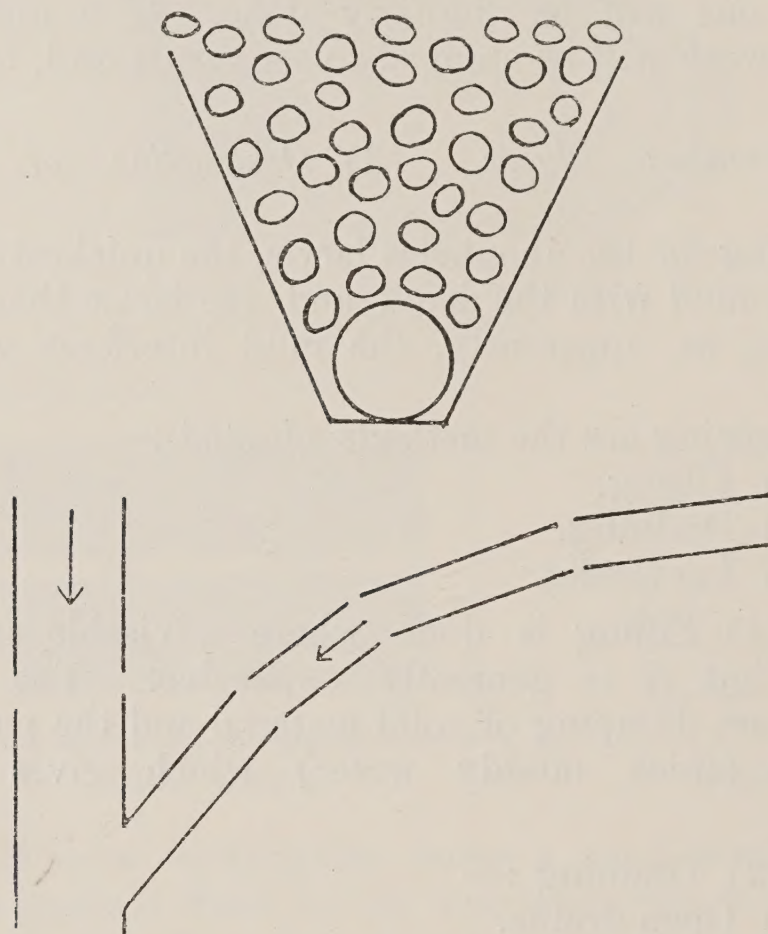
These should have weep holes at intervals, otherwise the material on which they rest gets washed away and cracks result. The edges of these must slope outwards from the drain, with a slight upward inclination to avoid holding any water.

It is suggested they may be made by putting in a small section of banana when laying the drain as it will last long enough for the concrete to set, and can be easily removed.

2. *Stone.*—If stone is available lay out the pieces to form the drain and then put a thick layer of cement over to hold them altogether.

3. *Dug-out Drains.*—These must be carefully graded, and the slope of the sides should not be more than 1 in 1. They require frequent cleaning, and except for temporary purposes are more expensive in the end than the cement or stone drains.

4. *Subsoil Drains*.—A carefully graded trench with slanting sides is dug with a fall of not less than 1 in 200, and a shape as in diagram. The bottom must just be wide enough to take the pipe, which should be 6 inches to 10 inches in diameter.



The pipes are laid $\frac{1}{8}$ inch apart, and covered with stones to ground level.

The stones will not get clogged if the ground around is covered with grass, and if that on the top side is not disturbed. If this should be done mud gets washed between the stones and pipes and the drain is spoilt, and must be re-laid. In connecting one subsoil drain with another an extra slope should be given to the tributary just before it enters the other in order to provide an extra flush at the point of junction and prevent clogging.

125. Drainage, besides being useful in ordinary ways, is very useful on embankments or hill sides to intercept seepage water before it comes to the surface.

Larvicides:—

- (a) Sea water.
- (b) Kerosine at 7 c. a gallon.
- (c) Crude petroleum at $2\frac{1}{2}$ c. a gallon.
- (d) Larvicide, which costs 17 c. a gallon.

(a) *Sea water*.—At Colon drains have been cut (as mentioned above), and sea water flows in. If the sea water cannot enter freely it is not much use, as larvæ have been found to grow in waters with an admixture of sea water below 40 per cent. of the latter.

(b) *Kerosine*.—This is not used alone, on account of its expense. In the process of burning, described below, it is used to dilute the crude oil.

126. (c) Larvicide is a mixture of carbolic acid, soda, and resin, prepared in the following way.

Contents :—

50 gallons crude carbolic of sp. gr. not greater than 0·96, and containing not less than 15 per cent. phenol.

66 lbs. of resin (to be thoroughly powdered).

10 lbs. caustic soda, 98 per cent. pure, dissolved in 2 gallons of water.

The carbolic acid is put into a boiler with a steam coil in the bottom, raised to the boiling point, and the resin gradually stirred in till thoroughly dissolved. The caustic soda solution is then added, keeping the mixture boiling, and stirred for five minutes.

The whole process takes $1\frac{1}{2}$ hours.

There is an engine used to provide the steam required which is kept solely for this purpose.

The cost of larvicide varies with the price of the carbolic, but is usually about 17 to 19 cents a gallon (about 9d.).

Larvicide is either mixed with the water containing the larvæ, and must then be used in such quantities as to make it a distinctly milky colour, or is used to mix with the crude oil.

127. *Methods employed*.—Cotton waste, dripping, spraying, burning and spraying.

128. *Cotton-waste method*.—Cotton waste on the end of a stick is soaked in crude oil for 24 hours then placed so as to be partially in the water. This method is sometimes used on embankments and sides of hills where there is seepage, but requires attention at short intervals.

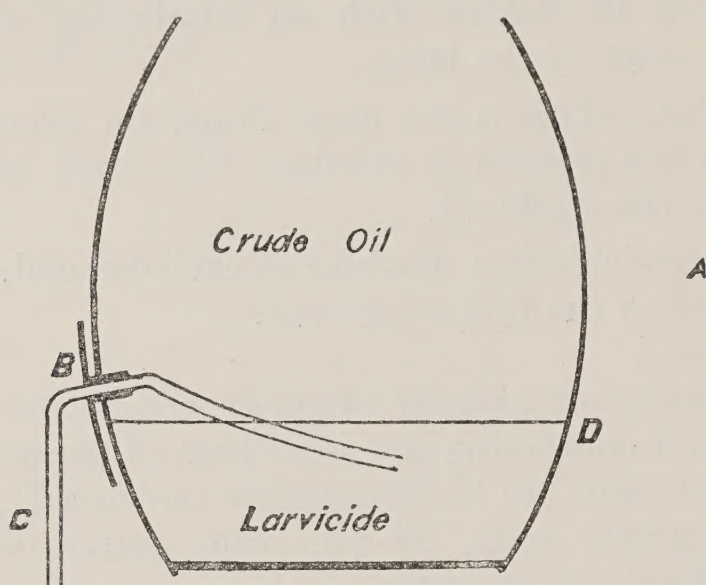
129. *Drip Methods*.—These are used in small streams or permanent drains. They require very little attention, in fact, may go on satisfactorily for weeks.

Barrels :—

A is an ordinary wooden barrel.

B is simply an ordinary tin wick holder inserted through the side of the barrel near the bottom.

C is piece of wick passing through the wick holder with the end outside hanging down over the water, and that inside lying at the bottom of the barrel.



Larvicide is put into the barrel up to the point *D*, and covers the inner end of the wick, and the barrel is then filled up with the crude oil.

The barrel is supported on bars over the water, and the oil drips on to its surface, the rate of drip being regulated by opening or compressing the tin wick holder.

The larvicide thins the oil in passing along the wick.

If the wick gets blocked it must be syringed with larvicide.

Kerosine tins are also used as drippers.

A hole is made in the bottom of the tin with a nail, and a strand of oakum passed through it so that one end hangs outside. Crude oil is put in the tin, which is suspended over the water, and the rate of drip depends on the tightness with which the oakum fits the hole.

130. *Spraying*.—Spraying is done by means of a Meyer's hand spray ; the cost of which is about \$10.

A man carries a tank of oil slung on his shoulders just like a knapsack, and with one hand he works the pump and with the other directs the spray.

If the oil is too thick it is diluted with larvicide as required.

This spray gives very satisfactory results, is much better and more convenient than those at present in use in Lagos, and only requires the labour of one man.

131. *Spraying and burning*.—This method is being introduced for treating edges of streams and drains, and when properly carried out keeps the growth down for a very long time. The first time it is done very thoroughly, and four men are required, but later burnings only necessitate

the services of one or two, as the oil may be carried in a tin knapsack arrangement.

Method.—The mixture used is :—

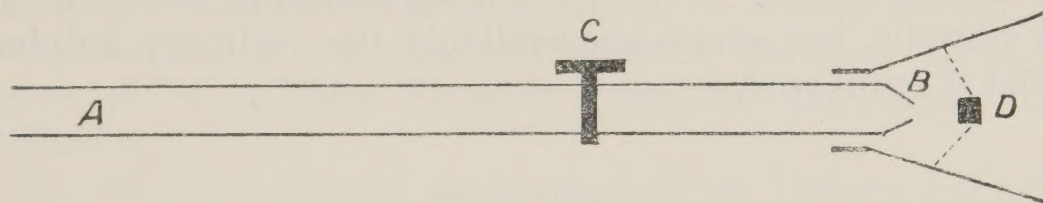
Crude oil, 5 gallons (cost 12 c.).

Pure kerosine, 1 gallon (cost 7 c.).

Total cost, 19 c. ($9\frac{1}{2}$ d.).

This is enough for about 250 square feet.

The mixture is placed in a barrel from which it is pumped by a double pump, one part of which takes up the mixture and another air, and then forces them mixed together along a hose which ends in a metal tube about 12 feet long with a sprinkler at its tip as in the spray. Around this a piece of tin is fixed as in diagram.



The oil and air mixture is pumped along the tube A through the sprinkler B, the flow being regulated by the tap C.

Spray impinges on a small disc D which is fixed in an inverted metal cone which covers the sprinkler, and which is thought to divide the spray better, and give more opportunity for vaporisation.

A little oil is first sprayed on the grass and fired. The end of the tube is put into the flames and the pump worked. The fire heats the sprinkler and inverted cone, and very soon, instead of the oil dropping down, it volatilizes and burns, and then continues to burn. A large flame is made, which is regulated by the supply, and is directed on the grass and weeds by the man holding the metal tube. By this means the grass, roots, &c., are burnt, and the land sprayed.

For future burnings a less heavy apparatus is being introduced. The iron tube is shorter, of a lighter character, passed through a piece of bamboo cane to keep it cool, and wrapped in asbestos for the last foot to prevent the wood burning.

A single-nozzle sprinkler is found to give better results than a double or treble one.

132. Edges of all streams and cut drains are cleared at intervals and sprayed with oil, but the method of firing and spraying described above will simplify this, be less expensive, and more lasting.

In larger streams and ponds the edges are well cleared, and they and the water are well sprayed.

Swamps are cleared as far as possible, drains cut, and looked after as above.

In some instances boats are used, especially in ponds, rivers, &c., so that a man may be the better able to treat the edges.

In some swamps large amounts of crude oil and larvicide are used.

133. *Issue of quinine*.—This method is also adopted, and has been of great service. In 1906 the amount used per mensem was 230 lbs. In 1910 192 lbs. were issued during the same period.

134. *Fumigation*.—The Clayton apparatus is used in the main stations, but where not available the ordinary sulphur method is employed.

SUGGESTIONS.

135. In regard to recommendations for future work there are several things to which I desire to draw attention.

(a) After seeing the minute way in which, at the hospitals at Panama and Colon (where I should mention the number of medical officers is greater in proportion to the work to be done than in Lagos) I realize more fully than ever that we do not make the most of the material at our disposal.

The Resident Medical Officer at the Lagos Hospital has, as I know from personal experience, so many and varied calls that it is impossible for him, single-handed, to do all that might be done. If an assistant, who could also act as pathologist, were to be appointed, it would be an advance of very great advantage.

(b) In the public mortuary a large number of post-mortem examinations are made annually by direction of the Coroner, of which no record is kept except by him for legal purposes. These cases would probably yield much useful information were careful notes made and kept. If an extra man were appointed at the hospital, as suggested above, it might possibly be arranged that he should do this work.

(c) In reference to the more careful examination of fever cases, some modification of the system of their inspection in practice in Habana might be adopted. An officer of experience should be authorised to visit the hospital daily and consult with the Resident Medical Officer. Should a case give rise to any suspicion of its being yellow fever in

the mind of either, a Committee, previously appointed for the purpose, should be at once called to see the patient.

(d) Medical men in the town should be called on to report any case of fever which they consider warrants a suspicion of yellow fever, and powers should be given the sanitary authorities to inspect such and take all necessary steps.

(e) Until there is a pipe-borne water supply in Lagos, which will enable a vast proportion of the water-containers to be done away with, the anti-mosquito work by the Inspectors must be rigidly continued. To do this satisfactorily the Inspectors ought to be under the continuous supervision of an officer who could devote his whole time to the work. Either the Medical Officer of Health should have an assistant or a very carefully selected European should be appointed as a Chief Sanitary Inspector, the former being preferable.

On the Gold Coast I understand West Indians have been brought over from Trinidad as Inspectors, but this is expensive, and I consider local candidates for posts should, if suitable, be given the preference.

(f) As regards fumigation work, some of the present Inspectors and the labourers attached to them should be trained for this purpose so that should occasion arise there will be no delay.

(g) Every necessary required in the process of sealing up and fumigation should be kept in the Municipal Sanitary Store.

Transport should be arranged for, and in any emergency nothing should have to be prepared or obtained.

(h) *Screening of Houses.*—My visit to Panama has more firmly convinced me than ever that houses (including verandahs) should be completely screened, and I feel confident the improvement in health and reduction in size of the daily sick-lists would show an ample return on the outlay.

The provision of a mosquito-proof room, or the screening of the building, leaving the verandah open, while better than nothing for those educated up to using them, will only give unsatisfactory results which will be used in endeavours to condemn the system and not the faulty methods of carrying it out.

In Panama all officers must choose between being in a screened house or in the open air, and never during the whole of my stay did I hear any complaint made nor did I

feel desirous of making one myself (the hotel in which I stayed was one huge mosquito-proof compartment).

(i) Doors of screened houses must all open outwards and be, as a matter of routine, fitted with strong springs to ensure proper closing.

Some such system of double doors as used in the hospitals at Para should be adopted, more especially in institutions.

(j) In all places where the wire gauze is liable to injury as in doors, hospitals, &c., it should be protected by wire netting on one or both sides, placed either immediately against it or leaving an interval between them which should vary with the size of the mesh of the netting.

(k) Electric fans of the horizontal type could be fitted in many houses in Lagos with advantage and would incidentally increase the private consumption of electricity.

They are used in many of the unscreened public resorts, both up the Amazon and on the Isthmus, and are much appreciated. Punkahs should be put up where electricity is not available. These means should minimise any sensation of closeness due to screening which might otherwise be observable.

(l) Sleeping accommodation somewhat after the style of that used in the labourers' dwellings and described above should be installed in all Government Kroo houses, which would thus be made much more sanitary and would render their cleaning much simpler than it is at present.

(m) *Drains*.—The present drains require extension in many parts of Lagos town. In all cases where proper roads are made drains should be laid down as a matter of course.

Arrangements should be made for the use of subsoil drains where conditions are suitable as they require so little attention.

(n) We should take more advantage of the trenching method of drainage than we do. It would render easier the attack on some of the breeding haunts of mosquitoes.

(o) Sprays of the type used in Panama should be introduced as they are so easily carried and worked, and are so effective.

In conjunction with drain-cutting and trenching the spray and burner is most useful and should be tried.

(p) Drippers similar to those described above will be of great assistance in some of the places in Lagos and in many other parts. They are very inexpensive and require little attention.

(*q*) Mosquito traps have been found to give very good results in Panama and should be introduced, especially in places where it is difficult or impossible to get rid of all breeding places. Colonel Gorgas considers this method a very valuable adjunct to other means where mosquitoes are plentiful.

(*r*) *Wells*.—Every householder likes to have his own well, but a number of those at present in use are a great source of danger. No wells should be allowed in future without permission.

As many as possible of those now existing should be closed and filled. The excuse generally given for them is that they are for washing purposes.

Certain wells, as those provided by Government and properly made, and any private ones certified by the Medical Officer of Health as properly covered and kept, might be allowed for drinking and other purposes.

All others should be regularly treated by the Inspectors on their weekly rounds to prevent mosquitoes breeding in them.

(*s*) As we all know, Lagos is greatly overcrowded, especially at the west end of the island.

Enquiries should be made and a scheme formulated for cutting thoroughfares through the worst parts and the facilities for egress and access should be increased to enable people to live outside the town.

(*t*) The question of the designation of houses in the town by numbers should be considered and commenced so that records can be kept for present information and future reference.

(*u*) Large open airy markets are very badly needed. The present ones are small and overcrowded; especially in regard to meat markets are improvements urgently required. These changes should be made to pay for themselves.

(*v*) The provision of a laundry would lead to a considerable diminution in the amount of parasitic skin disease which is at present so prevalent. This also is a matter which should yield a return, especially when one knows that some of the natives send shirts and collars to Liverpool to be laundried.

(*w*) In Panama it has been a question of floors with regard to rats. On the Coast it is mostly one of roofs. Influence and pressure should be exercised to persuade the owners to replace the thatch with galvanized iron, but later stronger measures may be required.

(*x*) *Larvicide*.—Whether it is advisable to start making larvicide on the same lines as in Panama is a matter which will require consideration, but trials of small quantities might be made.

(*y*) Proper refuse cans would be a great improvement on the open calabashes, &c., now used, and carried about, and it will be a great advance when every householder has to provide a proper receptacle for the collection and carrying away of his household refuse.

(*z*) A steam pressure disinfector should be obtained. This, however, if proper arrangements are made for using the Clayton apparatus, is not a matter of urgency.

NOTE.—Whatever regulations may be issued in the future suitable, their enforcement should be made as simple a matter as possible.

ARTHUR PICKELS.

LIST OF PAPERS, PHOTOGRAPHS, &C., ATTACHED.*

1. Report of Department of Sanitation of Isthmian Canal Commission, 1910.
2. Sanitary Staff. Isthmus of Panama.
3. Plans of Colon Sewage Pumping Station, Refuse Can, and Self-closing Stand.
4. Canal Commission Bungalows.
5. Colon Hospital, Quarters for Doctors and Nurses.
(Copied from Canal Commission Report.)
6. Colon Hospital.
7. Ancon Hospital, Panama.
8. Palo Seco Leper Asylum, Panama.
9. Quarantine Station, Panama.
10. " " "
11. " " "
12. The Market, Panama.
13. The Slaughter-house, Panama.
14. " " "
15. Laying Main Drain, Colon. (Copied from Canal Commission Report.)
16. Aqua Clara Reservoir for Water Supply. (Copied from Canal Commission Report.)
17. Trenching. (Copied from Canal Commission Report.)
18. Man Spraying. (Copied from Canal Commission Report.)
19. Burning. (Copied from Canal Commission Report.)
20. Washing up Mud used for filling in Swamps.
21. Dr. Thomas' Laboratory, Manaos.
22. Water Supply, Manaos.—The Pumping Station.
23. Water Supply, Manaos.—The Tank.
24. Beneficente Hospital, Manaos.
25. " " "
26. " " "
27. A Ward in the Lunatic Asylum, Kingston.

* Not reproduced.

